FIRST QUARTER 2011
GROUNDWATER MONITORING REPORT
YERINGTON MINE SITE

July 1, 2011

PREPARED FOR:

Atlantic Richfield Company
4 CENTERPOINTE DRIVE
LA PALMA, CALIFORNIA 90623

PREPARED BY:

Brown and Caldwell

3264 Goni Rd, Suite 153
Carson City, Nevada 89706
(775) 883-4118

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF PLATES

LIST OF TABLES

LIST OF APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

ARC	Atlantic Richfield Company
COC	Chain of Custody
CO_2	Carbon Dioxide
DC	Direct Current
DO	Dissolved Oxygen
DQI	Data Quality Indicators
DPT	Direct Push Technology
DWMP	Domestic Well Monitoring Plan
EPA	U.S. Environmental Protection Agency
ESI	Environmental Standards Inc.
FD	Field Duplicate
GMP	Groundwater Monitoring Plan
GMR	Groundwater Monitoring Report
HFA	Hydrogeologic Framework Assessment
ICP	Inductively Coupled Plasma
ICP-MS	Inductively Coupled Plasma-Mass Spectrometer
LEP	Lined Evaporation Pond
MDL	Method Detection Limit
MS/MSD	Matrix Spike/Matrix Spike Duplicate
N	Nitrogen
NA	Not Available
NDEP	Nevada Division of Environmental Protection
NR	Not Recorded
NTU	Nephelometric Turbidity Unit
ORP	Oxidation-Reduction Potential
OU	Operable Unit
PQL	Practical Quantitation Limit
PWS	Pumpback Well System
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RI/FS	Remedial Investigation/Feasibility Study
RPD	Relative Percent Difference
RPM	Remedial Project Manager
Site	Yerington Mine Site
SOP	Standard Operating Procedure
SOW	Scope of Work
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
UAO	Unilateral Administrative Order
UEP	Unlined Evaporation Pond
USGS	United States Geological Survey
V	Volt
VLT	Vat Leach Tailings

%	percent
amsl	above mean sea level
bgs	below ground surface
bmp	below measuring point
ft	foot / feet
L	liter
mg	milligram
ml/min	milliliters per minute
pCi	picocurie
psi	pounds per square inch
s.u.	standard units (pH)
µg	microgram
µm	micrometer or micron
µS/cm	microSiemens per centimeter

SECTION 1.0
INTRODUCTION

Atlantic Richfield Company (ARC) has prepared this *First Quarter 2011 Groundwater Monitoring Report* (1Q 2011 GMR) pursuant to Section 6.0 of the Scope of Work (SOW) attached to the Administrative Order for Remedial Investigation and Feasibility Study (RI/FS) for the Anaconda/Yerington Mine Site (Site), issued by the U.S. Environmental Protection Agency – Region 9 (EPA) to ARC on January 12, 2007 (EPA, 2007). This 1Q 2011 GMR has been prepared in accordance with the: 1) *Site-Wide Quality Assurance Project Plan - Revision 5* (QAPP; Environmental Standards, Inc. [ESI] and Brown and Caldwell, 2009) and attached standard operating procedures (SOPs); and 2) *Site-Wide Groundwater Monitoring Plan - Revision 1* (GMP; Brown and Caldwell, 2009) dated December 15, 2009.

The Site is located adjacent to the City of Yerington, in western Nevada (Figure 1-1). Also shown on Figure 1-1 are the Yerington Paiute Tribe reservation and the Paiute Indian Colony. Figure 1-2 depicts the locations of operable units (OUs) at the Site identified by EPA (2007). This 1Q 2011 GMR provides:

- a general description of the groundwater monitoring program and monitoring activities conducted during the previous quarter;
- a summary of water level measurements and water quality analyses for active monitor wells; and
- a discussion of any quality assurance/quality control (QA/QC) aspects of the water quality data.

The remainder of Section 1.0 of this 1Q 2011 GMR includes: 1) a description of regulatory requirements for groundwater monitoring (Section 1.1); 2) a description of the groundwater monitoring program objectives (Section 1.2); 3) a description of activities completed during 1Q 2011 related to groundwater monitoring activities and the monitor well network (Section 1.3); and 4) a summary of other groundwater investigation activities performed on the Site during 1Q 2011 (Section 1.4).

Section 2.0 presents a description of the groundwater monitoring program, including field measurements, field sample collection, and analytical methods. Section 3.0 presents 1Q 2011 groundwater elevation measurements and water quality data for the monitor wells. Section 4.0 provides the QA/QC summary for the 1Q 2011 analytical data, and the usability of the data. Section 5.0 lists the references cited in this 1Q 2011 GMR.

1.1 Regulatory Requirements for Groundwater Monitoring

Groundwater monitoring activities at the Site were initiated by the U.S. Geological Survey (USGS) in 1976 (Seitz et al., 1982). Subsequently, regulatory requirements for groundwater monitoring were initiated in 1982 in response to an Order issued by the Nevada Division of Environmental Protection (NDEP) to The Anaconda Company. Table 1-1 provides a brief chronological summary of regulatory requirements and groundwater monitoring activities for the Site. Chronological information on the pumpback well system (PWS) is provided in Appendix A of the *2009 Annual Groundwater Monitoring Report* (Brown and Caldwell, 2010a).

Table 1-1. Groundwater Monitoring Summary

1976	U. S. Geological Survey conducted groundwater investigations north of Site boundary.
1982 - 1984	Groundwater investigations in the vicinity of the sulfide tailings and evaporation ponds, including the installation of monitor wells (1982 NDEP Order).
1985 - 1994	Installation of additional monitor wells associated with the PWS and the northern portion of the Site (1985 NDEP Administrative Order).
2002	Installation of groundwater monitor wells MW2002-1S and MW2002-2S (NDEP interim action).
2005	Monitor wells installed pursuant to the First-Step Hydrologic Framework Assessment (HFA) and the Process Areas Work Plan (Unilateral Administrative Order (UAO) for Initial Response Activities; EPA Docket No. 9-2005-0011).
2007 - 2008	Monitor wells installed pursuant to the Second-Step HFA Work Plan. Submittal of Draft Site-Wide Groundwater Monitoring Plan (Administrative Order for Remedial Investigation and Feasibility Study, EPA Docket No. 9-2007-0005).
2009	Installation of monitor wells associated with the temporary shutdown of the PWS. Submittal of a separate Domestic Well Monitoring Plan (DWMP) that was implemented in March 2010, and resulted in separate DWMP reports (EPA letter dated November 11, 2009). Submittal of the Site-Wide GMP - Revision 1.
2010 - 2011	Installation of 123 monitor wells associated with the Site-Wide Groundwater Operable Unit (OU-1) and one monitor well (ST-A) as specified for the Evaporation Pond Removal Action (Thumb Pond and Sub-Area A).

1.2 Monitoring Program Objectives

The overarching objective of the groundwater monitoring program is to collect adequate data to support technical decisions that will be made by EPA's Remedial Project Manager (RPM), and project team, regarding the Site-Wide Groundwater Operable Unit (OU-1) and other OUs that require groundwater monitoring. Specific objectives include, but are not limited to:

- Characterization of groundwater flow conditions including hydrostratigraphy, horizontal and vertical gradients in the alluvial and bedrock aquifers, and the identification of flow boundaries and recharge sources;
- Characterization of the nature and extent, including temporal trends, of mine-related groundwater and potential off-Site migration of contaminants;
- Assessment of any potential human health and ecological risks associated with the groundwater pathway; and
- Continued evaluation of monitoring frequency, analytes to be monitored over time, and the appropriate configuration for the monitor wells network associated with the Site.

1.3 Summary of Groundwater Monitoring Activities

The current groundwater monitoring network associated with the Site, depicted in Figure 1-3 and Plate 1, has evolved over time (see Table 1-2) and includes 238 active wells: eleven pumpback wells used for groundwater extraction (currently in shutdown mode); 86 wells in the shallow zone; 41 wells in the intermediate zone; 73 wells in the deep zone; and 27 bedrock wells. Of the 238 monitor wells, seven are only used water level measurements, and the remaining 231 are monitored for both water levels and water quality. Well designations include a suffix that identifies the zone in which the well is screened (see Section 2.1).

Four wells, installed by Lyon County around the Penrose Wastewater Treatment Facility, were also sampled in 1Q 2011 and are included in the well totals summarized above. During 2Q 2009, the City of Yerington granted ARC access to these four wells located north and east of the treatment impoundment. As shown on Figure 1-3, this impoundment is located adjacent to West Campbell Ditch and north of the Peri agricultural fields. The wells were reportedly installed in January 2006 and are referred to in this report as LC-MW-1S, LC-MW-2S, LC-MW-3S, and LC-MW-5S. Available boring/well construction logs are included in Appendix A-1.

A visual inspection of the four Lyon County wells at the time of groundwater sampling in 2Q 2009 indicated discrepancies between field observations and the well logs. Consequently, ARC had the wells surveyed and measured the total depth of the wells to help ensure that water level measurements were accurate and to confirm that the wells monitor the shallow zone of the alluvial aquifer. The four Lyon County monitor wells are not formally included in the Groundwater Monitoring Program, but are temporarily monitored on a quarterly basis to assess their value to the program. ARC will evaluate the data and make a recommendation in a future report regarding the need to conduct further monitoring of any of these wells.

Table 1-2. Monitoring Locations (2007 – 2011)

Date (Through)	Total	Monitor Wells and/or Piezometers	Pumpback Wells
2007	87	76	11
2008	101	90	11
1Q 2009	110	99	11
2Q 2009	114*	107*	11
3Q 2009	114*	107*	11
4Q 2009	114*	107*	11
1Q 2010	114*	107*	11
2Q 2010	114*	107*	11
3Q 2010	114*	107*	11
4Q 2010	114*	107*	11
1Q 2011	238*	231*	11

Note: * includes four Lyon County wells

1.4 Summary of Other Groundwater Investigations

ARC conducted investigations pursuant to the *2010 Groundwater Monitor Well Work Plan - Revision 2* (Brown and Caldwell, 2010b) and the *Agricultural Field Characterization Work Plan - Revision 2* (Brown and Caldwell, 2010c). These investigations included borehole drilling and lithologic logging of subsurface materials, temporary well installation and development, depth-discrete groundwater sample collection and analysis, monitor well design, installation and development, measurement of water levels in monitor wells, groundwater sampling using direct push technology (DPT) methods, hydraulic (slug) testing of monitor wells, surface water sampling, and soil sample collection and analysis.

These groundwater characterization activities represent a phase of the RI required for OU-1. Groundwater monitor wells installed during the investigations have been incorporated into the Site-Wide Groundwater Monitoring Program, and the monitoring results are included in this report. The groundwater monitoring results and the results of all other aspects of the groundwater investigation activities will be presented in a data summary report, anticipated to be submitted to the EPA in 2Q or 3Q 2011.

Also during 2010, a groundwater monitor well referred to as ST-A was installed pursuant to the *Implementation Work Plan – Revision 3, Anaconda Evaporation Pond Removal Action (Thumb Pond and Sub-Area A)* (Brown and Caldwell, 2010d). The monitor well was installed in the alluvium beneath Sub-Area A and was dry at the time of installation. The well has been incorporated into the Site-Wide Groundwater Monitoring Program to evaluate potential future impacts to groundwater quality from the placement of vat leach tailing (VLT) as cover material.

SECTION 2.0
GROUNDWATER MONITORING PROGRAM

This section describes general aspects of the groundwater monitoring program and provides more specific information on water level measurements, water quality sampling, and analytical requirements pursuant to the *Site-Wide Groundwater Monitoring Plan - Revision 1* (Brown and Caldwell, 2009). Pumpback and monitor wells are sampled quarterly. Groundwater elevation measurements are obtained from monitor wells and piezometers on a monthly basis, but quarterly groundwater samples are only collected from monitor wells. Select wells are equipped with pressure transducers and data loggers to provide more frequent groundwater elevation data. Quarterly and annual reports describe monitoring results conducted during the previous quarter or year. Analytical results do not become available for inclusion in a report for a period of up to four months after a sample is collected due to laboratory and ARC QA/QC requirements.

2.1 Groundwater Zone Designations

Alluvial groundwater flow at the Site is discussed in this 1Q 2011 GMR in the context of shallow, intermediate and deep zones originally designated based on the occurrence of clay or fine-silt layers, initially identified by Seitz et al. (1982), and encountered during the drilling of monitor wells along the northern Site margin (Brown and Caldwell, 2005 and 2007). Subsequent lithologic logging of core from over 200 monitor well boreholes indicates that the clay or fine-silt layers are laterally discontinuous. Site-wide monitor wells are grouped into these three zones to identify wells with similar screen interval elevations, as follows:

- Shallow (S): >4,300 ft above mean sea level (amsl)
- Intermediate (I): 4,250 to 4,300 ft amsl
- Deep (D): <4,250 ft amsl; Given the thickness of alluvium, the deep zone is further subdivided as follows:
    - Deep 1 (D1): 4,200 to 4,250 ft amsl
    - Deep 2 (D2): 4,120 to 4,200 ft amsl
    - Deep 3 (D3): 4,000 to 4,120 ft amsl
    - Deep 4 (D4): 3,900 to 4,000 ft amsl
    - Deep 5 (D5): <3,900 ft amsl

A zone designation of "bedrock" (or "B") has been given to wells with screen intervals constructed in bedrock, below the alluvial soils, regardless of elevation.

2.2 Monitor Well Network

Wells included in the monitoring network must reliably represent Site-specific groundwater conditions and satisfy the following criteria: 1) documentation of drilling conditions, borehole depth and lithology, and well design and construction materials; and 2) screen intervals that are consistent in length (to the extent practicable), appropriate for the water-yielding intervals encountered in the boreholes, and generally less than or equal to 20 feet in length. Mitigating circumstances for the inclusion of monitor wells that do not meet the general and/or specific criteria previously discussed include wells that have been monitored for long periods and wells located for meeting the monitoring objectives described in Section 1.0.

2.2.1 Active Monitor Well Network

The current monitor well network is configured to account for:

1) Potential off-Site migration of mine-related groundwater (i.e., groundwater flow directions and potential solute migration pathways);
2) Seasonal effects associated with recharge to the Site, particularly the effects of agricultural operations immediately north of the Site (i.e., the effects of the irrigation mound on groundwater flow and quality);
3) Development of background water quality conditions; and
4) Characterization of potential localized sources of contaminants to groundwater.

Table 2-1 summarizes active monitor wells (bold, italicized well designations indicate the 124 wells installed from April 2010 through February 2011, and initially sampled during 1Q 2011). Additional monitor well construction details are provided in Appendix A-2. Monitor wells with screen intervals constructed in the shallow, intermediate and deep zones of the alluvial aquifer, and bedrock completions, are shown on Figures 2-1, 2-2, 2-3 and 2-4, respectively. A number of monitor wells installed at the Site have been abandoned and/or are inactive, and are not subject to the quarterly monitoring program. Additional information on these wells is provided in Appendix A-3, including a summary table and available construction information.

Table 2-1. Yerington Mine Groundwater Monitoring Wells (Active)

Revised/New Well Name(1)	Former Well Name	Groundwater Zone	Well Type	Well Screen Interval feet amsl
Pumpback Wells				
PW-1S	PW-1	Shallow	Sampling	4335.1 - 4312.6
PW-2S	PW-2	Shallow	Sampling	4335.6 - 4315.1
PW-3S	PW-3	Shallow	Sampling	4334.0 - 4313.5
PW-4S	PW-4	Shallow	Sampling	4331.5 - 4312.0
PW-5S	PW-5	Shallow	Sampling	4334.4 - 4313.9
PW-6S	PW-6	Shallow	Sampling	4340.0 - 4323.0
PW-7S	PW-7	Shallow	Sampling	4339.3 - 4319.8
PW-8S	PW-8	Shallow	Sampling	4336.7 - 4316.7
PW-9S	PW-9	Shallow	Sampling	4337.4 - 4317.4
PW-10S	PW-10	Shallow	Sampling	4338.6 - 4318.6
PW-11S	PW-11	Shallow	Sampling	4339.7 - 4319.7
Shallow Zone Monitor Wells				
B/W-1S	B/W-1S	Shallow	Sampling	4334.6 - 4314.6
B/W-3S	B/W-3S	Shallow	Sampling	4330.7 - 4310.7
B/W-4S	B/W-4S	Shallow	Sampling	4316.8 - 4296.8
B/W-5RS	B/W-5RS, -5SR	Shallow	Sampling	4326.1 - 4306.1
B/W-6S	B/W-6S	Shallow	Sampling	4326.6 - 4306.6
B/W-8S	B/W-8S	Shallow	Sampling	4326.0 - 4306.0
B/W-9S	B/W-9S	Shallow	Sampling	4331.7 - 4311.7
B/W-10S	B/W-10S	Shallow	Sampling	4321.5 - 4301.5
B/W-11S	B/W-11S	Shallow	Sampling	4330.1 - 4310.1
B/W-13S	B/W-13	Shallow	Sampling	4364.3 - 4344.3
B/W-14S	B/W-14	Shallow	Sampling	4357.0 - 4337.0
B/W-15S	B/W-15	Shallow	Sampling	4348.5 - 4328.5
B/W-16S	B/W-16	Shallow	Sampling	4328.8 - 4308.8
B/W-18S	B/W-18S	Shallow	Sampling	4333.8 - 4308.8
B/W-19S	B/W-19S	Shallow	Sampling	4331.6 - 4311.6
B/W-20S	B/W-20	Shallow	Sampling	4377.4 - 4357.4
B/W-21S	B/W-21	Shallow	Sampling	4339.0 - 4319.0
B/W-22S	B/W-22	Shallow	Sampling	4309.6 - 4289.6
B/W-25S	B/W-25S	Shallow	Sampling	4322.8 - 4302.8
B/W-27S	B/W-27S	Shallow	Sampling	4339.0 - 4319.0
B/W-28S	B/W-28S	Shallow	Sampling	4331.6 - 4311.6
B/W-29S	B/W-29S	Shallow	Sampling	4315.0 - 4295.0
B/W-30S		Shallow	Sampling	4325.2 - 4305.2
B/W-31S1		Shallow	Sampling	4331.0 - 4316.0
B/W-31S2		Shallow	Sampling	4304.8 - 4294.8
B/W-32S		Shallow	Sampling	4328.6 - 4308.6
B/W-33S		Shallow	Sampling	4328.3 - 4308.3
B/W-34S		Shallow	Sampling	4337.8 - 4317.8
B/W-36S		Shallow	Sampling	4329.8 - 4319.8
B/W-37S		Shallow	Sampling	4331.7 - 4311.7
B/W-38RS		Shallow	Sampling	4320.2 - 4300.2

Table 2-1. Yerington Mine Groundwater Monitoring Wells (Active)						
Revised/New Well Name(1)	**Former Well Name**	**Groundwater Zone**	**Well Type**	**Well Screen Interval**		
				feet amsl		
Shallow Zone Monitor Wells – Continued						
B/W-40S		Shallow	Sampling	4318.6	-	4298.6
B/W-41S		Shallow	Sampling	4324.8	-	4304.8
B/W-42S		Shallow	Sampling	4326.1	-	4306.1
B/W-43S		Shallow	Sampling	4323.8	-	4303.8
B/W-44S		Shallow	Sampling	4325.0	-	4305.0
B/W-45S		Shallow	Sampling	4332.1	-	4312.1
B/W-46S		Shallow	Sampling	4327.1	-	4307.1
B/W-52S		Shallow	Sampling	4330.2	-	4310.2
B/W-53S		Shallow	Sampling	4310.6	-	4290.6
B/W-55S		Shallow	Sampling	4327.4	-	4307.4
B/W-60S		Shallow	Sampling	4342.8	-	4322.8
B/W-61S		Shallow	Sampling	4342.0	-	4322.0
B/W-62S		Shallow	Sampling	4334.0	-	4314.0
B/W-64S		Shallow	Sampling	4347.8	-	4327.8
B/W-65S		Shallow	Sampling	4325.5	-	4305.5
B/W-66S		Shallow	Sampling	4313.9	-	4293.9
B/W-67S		Shallow	Sampling	4329.2	-	4309.2
B-2S	B-2	Shallow	Water Level	NR	-	NR
B-3S	B-3	Shallow	Water Level	NR	-	NR
D4BC-1S	D4BC-1	Shallow	Sampling	4333.9	-	4313.9
D5AC-1S	D5AC-1	Shallow	Sampling	4332.4	-	4327.4
LEP-MW-1S	LEP-MW-1S	Shallow	Sampling	4331.1	-	4321.1
LEP-MW-2S	LEP-MW-2S	Shallow	Sampling	4331.6	-	4321.6
LEP-MW-3S	LEP-MW-3S	Shallow	Sampling	4333.6	-	4323.6
LEP-MW-5S	LEP-MW-5S	Shallow	Sampling	4336.3	-	4326.3
LEP-MW-6S	LEP-MW-6S	Shallow	Sampling	4327.3	-	4317.3
LEP-MW-7S	LEP-MW-7S	Shallow	Sampling	4342.9	-	4332.9
MW-2S	MW-2	Shallow	Sampling	4326.6	-	4311.6
MW-4S	MW-4	Shallow	Sampling	4325.7	-	4310.7
MW-5S	MW-5	Shallow	Sampling	4331.0	-	4316.0
MW2002-1S	MW2002-1	Shallow	Sampling	4331.9	-	4321.9
MW2002-2S	MW2002-2	Shallow	Sampling	4324.1	-	4314.1
PA-MW-1S	PA-MW-1	Shallow	Sampling	4346.7	-	4326.7
PA-MW-2S	PA-MW-2	Shallow	Sampling	4347.1	-	4327.1
PA-MW-3S	PA-MW-3	Shallow	Sampling	4348.1	-	4328.1
PW10-P1	P-1 and P-1S	Shallow	Water Level	4339.1	-	4319.1
ST-A		Shallow	Sampling	4403.4	-	4393.4
USEPA2S	USEPA2	Shallow	Sampling	4348.3	-	4338.3
USGS-13S	USGS-13	Shallow	Sampling	4342.1	-	4332.1
USGS-2BS	USGS-2B	Shallow	Sampling	4326.5	-	4324.6
UW-1S	UW-1	Shallow	Sampling	4332.7	-	4312.7
W5AA-2S	W5AA-2	Shallow	Water Level	4333.2	-	4313.2
W5AA-3S	W5AA-3	Shallow	Sampling	4342.8	-	4332.8
W5AB-2S	W5AB-2	Shallow	Sampling	4337.5	-	4322.5
W5AD-1S	W5AD-1	Shallow	Water Level	4330.9	-	4325.9

Table 2-1. Yerington Mine Groundwater Monitoring Wells (Active)

Revised/New Well Name[(1)]	Former Well Name	Groundwater Zone	Well Type	Well Screen Interval feet amsl
Shallow Zone Monitor Wells – Continued				
W5BB-S	W5BB	Shallow	Sampling	4337.1 - 4307.1
W5DB-S		Shallow	Sampling	4345.1 - 4325.1
WRP-1S	WRP-1	Shallow	Water Level	4382.8 - 4372.8
WRP-2S	WRP-2	Shallow	Water Level	4382.6 - 4372.6
WW-1S	WW-1	Shallow	Sampling	4364.2 - 4344.2
WW-2S	WW-2	Shallow	Sampling	4339.4 - 4319.4
Lyon County Wells				
LC-MW-1S	LC-MW-01S	Shallow	Sampling	NA - 4303.8
LC-MW-2S	LC-MW-02S	Shallow	Sampling	NA - 4313.9
LC-MW-3S	LC-MW-03S	Shallow	Sampling	NA - 4323.7
LC-MW-5S	LC-MW-05S	Shallow	Sampling	NA - 4323.1
Intermediate Zone Monitor Wells				
B/W-2I	B/W-2I	Intermediate	Sampling	4279.7 - 4259.7
B/W-3I	B/W-3I	Intermediate	Sampling	4266.0 - 4246.0
B/W-4I	B/W-4I	Intermediate	Sampling	4276.5 - 4256.5
B/W-5RI	B/W-5RI, -5IR	Intermediate	Sampling	4278.9 - 4258.9
B/W-6I	B/W-6D	Intermediate	Sampling	4260.0 - 4250.0
B/W-7I	B/W-7	Intermediate	Sampling	4304.8 - 4284.8
B/W-8I	B/W-8D	Intermediate	Sampling	4284.3 - 4264.3
B/W-9I	B/W-9I	Intermediate	Sampling	4281.3 - 4261.3
B/W-19I	B/W-19I	Intermediate	Sampling	4281.6 - 4261.6
B/W-27I		Intermediate	Sampling	4275.0 - 4255.0
B/W-28I	B/W-28I	Intermediate	Sampling	4277.4 - 4257.4
B/W-29I	B/W-29I1	Intermediate	Sampling	4288.0 - 4278.0
B/W-30I		Intermediate	Sampling	4267.7 - 4247.7
B/W-31I		Intermediate	Sampling	4287.9 - 4247.9
B/W-32I		Intermediate	Sampling	4286.7 - 4266.7
B/W-33I		Intermediate	Sampling	4265.3 - 4255.3
B/W-34I		Intermediate	Sampling	4303.9 - 4283.9
B/W-37I		Intermediate	Sampling	4296.9 - 4276.9
B/W-38RI		Intermediate	Sampling	4287.0 - 4267.0
B/W-41I		Intermediate	Sampling	4278.5 - 4268.5
B/W-42I		Intermediate	Sampling	4266.2 - 4246.2
B/W-46I		Intermediate	Sampling	4277.0 - 4257.0
B/W-51I1		Intermediate	Sampling	4304.0 - 4294.0
B/W-51I2		Intermediate	Sampling	4264.2 - 4244.2
B/W-52I		Intermediate	Sampling	4296.1 - 4276.1
B/W-53I		Intermediate	Sampling	4266.3 - 4256.3
B/W-54I1		Intermediate	Sampling	4298.6 - 4288.6
B/W-54I2		Intermediate	Sampling	4277.2 - 4267.2
B/W-65I		Intermediate	Sampling	4285.6 - 4265.6
B/W-66I		Intermediate	Sampling	4269.3 - 4249.3
B/W-67I		Intermediate	Sampling	4289.4 - 4269.4
LEP-MW-4I	LEP-MW-4I2	Intermediate	Sampling	4267.0 - 4257.0
LEP-MW-8I	LEP-MW-8I2	Intermediate	Sampling	4271.8 - 4261.8

Table 2-1. Yerington Mine Groundwater Monitoring Wells (Active)				
Revised/New Well Name(1)	Former Well Name	Groundwater Zone	Well Type	Well Screen Interval feet amsl
Intermediate Zone Monitor Wells – Continued				
LEP-MW-9I	LEP-MW-9I2	Intermediate	Sampling	4258.0 - 4248.0
MW-4I		Intermediate	Sampling	4285.2 - 4265.2
MW-5I		Intermediate	Sampling	4269.8 - 4249.8
W4CB-1I	W4CB-1	Intermediate	Sampling	4280.2 - 4265.2
W4CB-2I	W4CB-2	Intermediate	Sampling	4307.9 - 4295.9
W5AA-1I	W5AA-1	Intermediate	Sampling	4293.4 - 4278.4
W5AB-3I	W5AB-3	Intermediate	Sampling	4309.0 - 4284.5
W5DB-I		Intermediate	Sampling	4288.0 - 4268.0
Deep Zone Monitor Wells				
B/W-1D1	B/W-1I1	Deep	Sampling	4230.4 - 4210.4
B/W-1D2	B/W-1I2	Deep	Sampling	4139.8 - 4119.8
B/W-1D3	B/W-1D	Deep	Sampling	4028.6 - 4018.6
B/W-1D5		Deep	Sampling	3877.4 - 3867.4
B/W-2D1	B/W-2D	Deep	Sampling	4224.3 - 4204.3
B/W-2D3		Deep	Sampling	4049.2 - 4029.2
B/W-2D4		Deep	Sampling	3939.3 - 3919.3
B/W-3D1	B/W-3D	Deep	Sampling	4222.0 - 4202.0
B/W-4D1	B/W-4D	Deep	Sampling	4228.1 - 4208.1
B/W-5RD1	B/W-5RD, -5DR	Deep	Sampling	4241.5 - 4221.5
B/W-9D2	B/W-9D	Deep	Sampling	4206.8 - 4186.8
B/W-10D1	B/W-10D	Deep	Sampling	4241.0 - 4221.0
B/W-11D2	B/W-11D	Deep	Sampling	4197.7 - 4177.7
B/W-18D1	B/W-18I	Deep	Sampling	4232.8 - 4212.8
B/W-18D2	B/W-18D	Deep	Sampling	4194.2 - 4174.2
B/W-19D1	B/W-19D	Deep	Sampling	4216.6 - 4196.6
B/W-25D1	B/W-25I	Deep	Sampling	4249.9 - 4229.9
B/W-25D2	B/W-25D	Deep	Sampling	4134.0 - 4114.0
B/W-27D3a	B/W-27D	Deep	Sampling	4124.8 - 4104.8
B/W-27D3b		Deep	Sampling	4023.0 - 4003.0
B/W-28D1	B/W-28D	Deep	Sampling	4221.9 - 4201.9
B/W-29D1	B/W-29I2	Deep	Sampling	4225.0 - 4215.0
B/W-29D3	B/W-29D	Deep	Sampling	4050.0 - 4030.0
B/W-30D1		Deep	Sampling	4229.0 - 4209.0
B/W-31D2		Deep	Sampling	4199.9 - 4179.9
B/W-32D2		Deep	Sampling	4147.7 - 4127.7
B/W-32D5		Deep	Sampling	3886.8 - 3866.8
B/W-33D1		Deep	Sampling	4239.5 - 4229.5
B/W-34D1		Deep	Sampling	4256.1 - 4236.1
B/W-37D1		Deep	Sampling	4218.9 - 4198.9
B/W-38RD1		Deep	Sampling	4210.8 - 4190.8
B/W-40D1		Deep	Sampling	4222.6 - 4202.6
B/W-40D3		Deep	Sampling	4057.9 - 4037.9
B/W-41D2		Deep	Sampling	4198.4 - 4178.4
B/W-41D4		Deep	Sampling	4004.3 - 3984.3
B/W-42D1		Deep	Sampling	4211.0 - 4191.0

Table 2-1. Yerington Mine Groundwater Monitoring Wells (Active)

Revised/New Well Name[(1)]	Former Well Name	Groundwater Zone	Well Type	Well Screen Interval feet amsl
Deep Zone Monitor Wells – Continued				
B/W-44D1		Deep	Sampling	4229.8 - 4209.8
B/W-44D2		Deep	Sampling	4152.8 - 4132.8
B/W-45D1		Deep	Sampling	4252.8 - 4232.8
B/W-45D2		Deep	Sampling	4210.0 - 4190.0
B/W-46D1		Deep	Sampling	4219.9 - 4199.9
B/W-52D2		Deep	Sampling	4178.0 - 4158.0
B/W-55D1		Deep	Sampling	4251.7 - 4241.7
B/W-55D2		Deep	Sampling	4171.6 - 4151.6
B/W-60D1		Deep	Sampling	4247.8 - 4227.8
B/W-60D3		Deep	Sampling	4036.8 - 4016.8
B/W-60D5		Deep	Sampling	3881.9 - 3861.9
B/W-61D1		Deep	Sampling	4247.2 - 4227.2
B/W-61D3		Deep	Sampling	4037.0 - 4017.0
B/W-62D1		Deep	Sampling	4243.8 - 4223.8
B/W-62D2		Deep	Sampling	4174.0 - 4154.0
B/W-62D4		Deep	Sampling	3954.1 - 3934.1
B/W-62D5		Deep	Sampling	3834.2 - 3814.2
B/W-64D1		Deep	Sampling	4259.9 - 4239.9
B/W-64D2		Deep	Sampling	4175.8 - 4155.8
B/W-65D1		Deep	Sampling	4213.6 - 4193.6
B/W-65D5		Deep	Sampling	3750.7 - 3740.7
B/W-66D1		Deep	Sampling	4208.9 - 4188.9
B/W-66D5		Deep	Sampling	3761.1 - 3751.1
B/W-67D1		Deep	Sampling	4245.3 - 4225.3
B/W-67D3		Deep	Sampling	4125.0 - 4105.0
LEP-MW-2D1		Deep	Sampling	4230.1 - 4210.1
LEP-MW-2D3		Deep	Sampling	4100.3 - 4080.3
MW2002-2D1	MW2002-2I	Deep	Sampling	4249.7 - 4239.7
MW-5D2		Deep	Sampling	4194.5 - 4174.5
MW-5D3		Deep	Sampling	4119.3 - 4099.3
W4CB-2D1		Deep	Sampling	4240.6 - 4220.6
W4CB-2D3		Deep	Sampling	4065.8 - 4045.8
W4CB-2D4		Deep	Sampling	3965.6 - 3955.6
W5DB-D1	W5DB, W5DB-D	Deep	Sampling	4239.6 - 4211.6
W5DB-D3		Deep	Sampling	4092.0 - 4072.0
W5DB-D4		Deep	Sampling	4010.0 - 3990.0
W32DC-D1	W32DC, W32DC-D	Deep	Sampling	4240.4 - 4197.4
Bedrock Monitor Wells				
B/W-1B		Bedrock	Sampling	3699.8 - 3689.8
B/W-2B		Bedrock	Sampling	3839.4 - 3819.4
B/W-6B		Bedrock	Sampling	4172.4 - 4152.4
B/W-11B	B/W-11D3	Bedrock	Sampling	4132.9 - 4122.9
B/W-22B		Bedrock	Sampling	4261.5 - 4241.5
B/W-23B	B/W-23	Bedrock	Sampling	4340.3 - 4330.3
B/W-33B		Bedrock	Sampling	4167.6 - 4157.6

Table 2-1. Yerington Mine Groundwater Monitoring Wells (Active)

Revised/New Well Name[(1)]	Former Well Name	Groundwater Zone	Well Type	Well Screen Interval feet amsl		
Bedrock Monitor Wells - Continued						
B/W-34B		Bedrock	Sampling	4203.8	-	4183.8
B/W-36B		Bedrock	Sampling	4271.7	-	4261.7
B/W-37B		Bedrock	Sampling	4166.9	-	4146.9
B/W-38RB		Bedrock	Sampling	4167.0	-	4147.0
B/W-39B		Bedrock	Sampling	4309.0	-	4299.0
B/W-44B		Bedrock	Sampling	4124.5	-	4104.5
B/W-51B		Bedrock	Sampling	4198.9	-	4188.9
B/W-53B		Bedrock	Sampling	4241.2	-	4221.2
B/W-54B		Bedrock	Sampling	4261.3	-	4251.3
B/W-61B		Bedrock	Sampling	3684.2	-	3664.2
B/W-62B		Bedrock	Sampling	3690.9	-	3670.9
B/W-64B		Bedrock	Sampling	4090.0	-	4070.0
LEP-MW-2B		Bedrock	Sampling	4040.6	-	4020.6
MW-4B		Bedrock	Sampling	4251.4	-	4231.4
MW-5B		Bedrock	Sampling	3984.4	-	3964.4
W4CB-2B		Bedrock	Sampling	3844.7	-	3824.7
W5DB-B		Bedrock	Sampling	3781.2	-	3761.2
WW-36B	WW-36	Bedrock	Sampling	4306.0	-	4106.0
WW-40B	WW-40	Bedrock	Sampling	NR	-	NR
WW-59B	WW-59	Bedrock	Sampling	4280.1	-	3888.1

Note: (1) Names of wells installed during April 2010 through February 2011 and initially sampled during the 1Q 2011 event are bold and italicized.
NR means "not recorded" on well construction logs.
NA means "not available". The bottom of screen elevations for the Lyon County wells are based on a 2009 survey conducted for ARC and field measurements of the total depth of each well taken by Brown and Caldwell. The measured well depths are not consistent with the information on the well logs provided by Lyon County (see Appendix A-1 for the well logs).
amsl means "above mean sea level".

2.2.2 Monitoring Program Modifications During 1Q 2011

Modifications to the groundwater monitoring program and/or unique occurrences during the 1Q 2011sampling event listed below:

- The 123 monitor wells installed as part of the Site-Wide Groundwater OU-1 and monitor well ST-A were incorporated into the Site-Wide Groundwater Monitoring Program.
- The sample from B/W-41D4 was not analyzed for radiological parameters because of limited sample volume. The sample was highly turbid and was clogging the sample filters.

2.3 Water Level Monitoring

Water levels in each well were manually measured on January 24-26, March 1-3, and March 28-31, 2011. Groundwater levels were not measured in well WW-36B due to in-place pumping equipment. Pursuant to the Second-Step HFA (Brown and Caldwell, 2007) and the PWS Work Plan (Brown and Caldwell, 2008), water levels have been measured in 30- or 60-minute intervals beginning in mid-2007 at key locations using dedicated pressure transducers and data loggers.

As indicated in Table 2-2, a total of 72 wells were instrumented in 1Q 2011 for water level and specific conductivity measurements. On March 11, 2011, a pressure transducer in B/W-1D3 was removed and placed in B/W-1D5, and a pressure transducer was placed in W5DB-S. Data were recorded at 30-minute intervals except for PW10-P1 (60-minute interval). Agricultural well WDW019 was not pumped during 1Q 2011, and its pump was removed in March 2011. Figures 2-5, 2-6, 2-7, and 2-8, respectively, depict the locations of shallow, intermediate, deep and bedrock wells equipped with pressure transducers/data loggers.

Table 2-2. Wells Instrumented for Water Level and Specific Conductivity Measurements

Existing Wells	Data Type	Groundwater Unit Designation
B-3S	Water Level	Shallow Alluvium
B/W-1S	Water Level	Shallow Alluvium
B/W-1D1	Water Level	Deep Alluvium
B/W-1D5*	Water Level, Specific Conductivity	Deep Alluvium
B/W-2D1	Water Level	Deep Alluvium
B/W-2I	Water Level	Intermediate Alluvium
B/W-3S	Water Level	Shallow Alluvium
B/W-3I	Water Level	Intermediate Alluvium
B/W-3D1	Water Level	Deep Alluvium
B/W-4S	Water Level	Shallow Alluvium
B/W-4I	Water Level	Intermediate Alluvium
B/W-4D1	Water Level	Deep Alluvium
B/W-8S	Water Level	Shallow Alluvium
B/W-8I	Water Level	Intermediate Alluvium
B/W-9S	Water Level, Specific Conductivity	Shallow Alluvium
B/W-9I	Water Level	Intermediate Alluvium
B/W-9D2	Water Level	Deep Alluvium
B/W-10S	Water Level	Shallow Alluvium
B/W-11B	Water Level	Bedrock
B/W-11S	Water Level	Shallow Alluvium
B/W-11D2	Water Level	Deep Alluvium
B/W-18S	Water Level	Shallow Alluvium

Table 2-2. Wells Instrumented for Water Level and Specific Conductivity Measurements

Existing Wells	Data Type	Groundwater Unit Designation
B/W-25S	Water Level	Shallow Alluvium
B/W-25D1	Water Level	Deep Alluvium
B/W-25D2	Water Level	Deep Alluvium
B/W-27S	Water level	Shallow Alluvium
B/W-27D3a	Water Level	Deep Alluvium
B/W-28S	Water Level	Shallow Alluvium
B/W-28I	Water Level	Intermediate Alluvium
B/W-29S	Water Level	Shallow Alluvium
B/W-29I	Water Level	Intermediate Alluvium
B/W-29D1	Water Level, Specific Conductivity	Deep Alluvium
LEP-MW-4I	Water Level	Intermediate Alluvium
LEP-MW-8I	Water Level, Specific Conductivity	Intermediate Alluvium
LEP-MW-9I	Water Level, Specific Conductivity	Intermediate Alluvium
MW2002-1S	Water Level	Shallow Alluvium
MW2002-2S	Water Level	Shallow Alluvium
MW-4S	Water Level	Shallow Alluvium
MW-5S	Water level	Shallow Alluvium
PA-MW-3S	Water level	Shallow Alluvium
PW10-P1	Water Level	Shallow Alluvium
UW-1S	Water Level	Shallow Alluvium
W4CB-1I	Water Level, Specific Conductivity	Intermediate Alluvium
W5AA-1I	Water Level	Intermediate Alluvium
W5AA-2S	Water Level	Shallow Alluvium
W5AB-2S	Water Level	Shallow Alluvium
W5AB-3I	Water Level	Intermediate Alluvium
W5BB-S	Water Level	Shallow Alluvium
W5DB-D1	Water Level	Deep Alluvium
WRP-1S	Water Level	Shallow Alluvium
WRP-2S	Water Level	Shallow Alluvium
New Wells	**Data Type**	**Groundwater Unit Designation**
B/W-6B	Water Level	Bedrock
B/W-6S	Water Level	Shallow Alluvium
B/W-6I	Water Level	Intermediate Alluvium
B/W-22B	Water Level	Bedrock
B/W-22S	Water Level	Shallow Alluvium
B/W-30I	Water Level	Intermediate Alluvium
B/W-30S	Water Level	Shallow Alluvium
B/W-32S	Water Level	Shallow Alluvium
B/W-34D1	Water Level	Deep Alluvium
B/W-34I	Water Level	Intermediate Alluvium
B/W-34S	Water Level	Shallow Alluvium
B/W-42I	Water Level	Intermediate Alluvium
B/W-42S	Water Level	Shallow Alluvium
B/W-61D1	Water Level	Deep Alluvium
B/W-61S	Water Level	Shallow Alluvium

Table 2-2. Wells Instrumented for Water Level and Specific Conductivity Measurements

New Wells	Data Type	Groundwater Unit Designation
B/W-64S	Water Level	Shallow Alluvium
B/W-67D1	Water Level	Deep Alluvium
B/W-67I	Water Level	Intermediate Alluvium
B/W-67S	Water Level	Shallow Alluvium
W5DB-S	Water Level	Shallow Alluvium
MW-4B	Water Level	Bedrock

* Transducer in B/W-1D3 was removed 3/11/2011 and installed in B/W-1D5

Water levels were measured and recorded according to the requirements of the *Monitor Well Water Level Measurement Standard Operating Procedure (SOP-16)*, summarized as follows:

1. Monthly water level measurements should be collected over a consolidated period, not exceeding three days if possible, during the last week of each month. The sampler shall carry a record of the most recent measurements for comparison.
2. Unlock and open the well and remove the well cap gently to avoid creating air suction on the water column.
3. The probe of the electric water level indicator is lowered into the well until water is encountered, as indicated by the instrument signal. The water level is then measured to an accuracy of 0.01 feet with respect to the 'measuring point', marked on the top of the inner well casing, and entered on field log or field book. Typically, the field technician will raise and lower the probe several times over the course of a minute taking several readings to ensure an accurate reading is obtained.
4. The actual water level meter used to take the measurement is recorded in the field notes and the same meter is used consistently for each monthly reading to ensure variations in tape lengths do not provide inaccurate measurements.
5. The water level probe and at least two feet of tape are decontaminated after each well using *Standard Decontamination Procedures (SOP-05)* with Alconox® soap and distilled water.

2.4 Monitor Well Groundwater Quality Sampling

Monitor wells identified as sampling wells in Table 2-1 were sampled and analyzed for the list of parameters presented in Table 2-3. The majority of wells wee sampled using dedicated bladder pumps and the low-flow sampling procedure described below. Monitor wells were sampled during the period of February 13, 2011 through March 2, 2011, and from the B/W-41 well cluster (-I, -D2, and -D4) on March 24, 2011.

Low-Flow Sampling Procedure

Groundwater sampling was conducted according to the requirements of the *Groundwater Sample Collection Standard Operating Procedure (SOP-09)*, attached to the revised QAPP (ESI and Brown and Caldwell, 2009), and additional requirements identified in the GMP. Prior to sampling, the static water level in each monitor well was measured and recorded using an electronic water level indicator probe. Water levels were continually monitored during the purging and sampling procedure to ensure that excessive drawdown the aquifer did not occur.

Most samples were collected using the low-flow sampling method with dedicated bladder pumps actuated by compressed air, pressurized carbon dioxide (CO_2) gas, or pressurized nitrogen (N) gas. Compressed air was generated by an air compressor powered by a 12 volt (V) direct current (DC) motor provided by a car battery, used for shallow wells generally less than 100 feet below ground surface (bgs). Pumps set at depths greater than 250 feet bgs required the use of compressed CO_2 and N gas cylinders to achieve the pounds per square inch (psi) levels needed to pump the sample to the surface. Compressed CO_2 gas was used for some shallow wells, less than 250 feet.

Upon arrival at the well location, the sampler adhered to the following procedures to set up equipment, purge the well, monitor water quality parameters, and collect the sample:

1. Unlock the well cap and open the well.
2. Take a preliminary static water level measurement.
3. Connect the compressed air/gas supply to the pump controller and connect the air supply line from the controller to the air inlet tube at the well head.
4. Connect the sample discharge tube from the well head to the YSI flow-through cell.
5. Turn on the compressed air/gas supply.
6. Turn the pump controller on and adjust the psi, and refill and discharge times on the controller to achieve a pumping rate between 100 and 500 milliliters per minute (ml/min). The maximum pumping rate of 500 ml/min may be exceeded to facilitate purging of one well screen volume provided that drawdown does not exceed 0.3 feet. The pumping rate is measured by collecting water from the discharge tube into a measuring cup over a measured time period. Once these parameters have been established, they are recorded and used to guide future sampling of the wells.
7. Begin monitoring water quality parameters every five minutes and record data on the Monitor Well Sampling Log. Monitored parameters include:

- temperature
- specific conductance
- dissolved oxygen (DO)
- pH
- oxidation-reduction potential (ORP)
- turbidity

8. Monitor water level measurements at an adequate frequency to ensure drawdown is less than 0.3 feet. Adjust pumping rate if drawdown exceeds this limit.
9. Continue monitoring water quality parameters until parameters are stabilized, as defined in SOP-09 and on the Monitor Well Sampling Log form, or until one well screen volume has been purged (if parameters have stabilized).
10. Remove the discharge line from the flow-through cell and collect samples in laboratory provided, pre-preserved bottles, per the requirements of the QAPP. Samples that require field filtration are filtered through a single-use in-line 0.45 micron (μm) filter applied to the discharge line. Apply labels to the sample bottles, fill in details on the pre-printed chain-of-custody (COC) forms, and place samples in a cooler with ice until preparation for shipment to the lab.
11. Turn off equipment, disconnect from the well head, close and lock the well monument.

All equipment that was in contact with a groundwater sample during sample collection was dedicated to each individual well and, therefore, did not require decontamination. All field filters were single use and were discarded after use. The YSI probe and flow-through cell, although it was reused at each well, was disconnected from the system before the sample was collected and therefore did not require formal decontamination procedures. However, it was adequately rinsed between use at each well. In the case of dedicated bladder pumps, no reusable equipment was used during sample collection. Therefore, no decontamination procedures were necessary and equipment rinsate blanks did not need to be collected.

Other Sampling Procedures

Twenty wells were sampled by a method other than the low-flow bladder pump. A brief summary of the sampling methods is provided below:

- Production Pump: Three wells (WW-36B, WW-40B, and WW-59B) are equipped with dedicated production pumps that are used for sample collection. These pumps are operated by either a direct connection to electrical service lines or a temporary connection to a portable electrical generator. In the case of WW-36B (used for the Weed Heights water supply), the well operates continuously so there are no requirements for purging the well or measuring stabilization of field parameters. The sample is collected by opening the sample spigot and collecting the filtered and unfiltered samples in the laboratory-provided bottles. Wells that are not operated continuously require a purge volume of three times the well casing volume. Wells WW-40B and WW-59B have very large casing volumes that require four to eight hours of purge time.
- Peristaltic Pump: Six wells (USGS-2BS, LEP-MW-5S, LC-MW-1S, LC-MW-2S, LC-MW-3S, and LC-MW-5S) have screens that only partially penetrate the shallow stratigraphic zone under current hydrologic conditions. Therefore, the column of water in the well screen is insufficient to allow use of the bladder pump sampling method. Consequently, a small electrical peristaltic pump that operates off a car battery is used. The pump is a type of positive displacement pump and operates with a controller to allow pumping at slow rates and parameter stabilization monitoring. The sample tubing is disposable; thus, no decontamination is required between wells.
- Electric Submersible Pump: During 2Q 2010, pump tests were conducted on the eleven Pumpback wells as part of PWS characterization activities. Electric-powered submersible pumps were used during the PWS pump tests. At the time of the 3Q 2010 sampling event, the submersible pumps used during the pump tests had been installed back into the eleven PWS wells (PW-1S through PW-11S). Therefore, the submersible pumps that were installed in the eleven respective PWS wells were used to purge and sample the well during 1Q 2011. Three well volumes of water were purged from each of the eleven PWS wells before collection of a sample, as specified in the QAPP. Because the pumps used during the pump tests were dedicated to each respective well, decontamination was not needed before purging and sampling.

Field Meter Calibration

All field meters, including turbidity meters and water quality parameter meters used during sampling, were calibrated or verified each morning in accordance with certified calibration standards, to ensure the meters provided accurate data. The YSI-556 MPS meters were calibrated for pH (using a 3-point slope with 4.0, 7.0, and 10.0 calibration solutions), specific conductance (typically calibrated to a 1,413 microSiemens per centimeter (μS/cm) standard and verified with 447 μS/cm and 8,974 μS/cm standards), ORP (calibrated to a temperature dependent, vendor-specified, value), and DO (calibrated to barometrically adjusted open air and verified with a zero-oxygen standard). All meters were verified with a calibration drift check procedure at the end of each day that included reading the same calibration standards and recording the readings on the calibration log sheets.

Turbidity meters (HF Scientific MicroTPW Field Portable Turbidimeters) were calibrated each morning to a three-point curve using certified standards of 0.2, 10.0, and 1,000 nephelometric turbidity units (NTUs). The meters were verified against the same standards at the end of the day to determine if they operated properly and if their accuracy had drifted.

Laboratory Analysis

The samples collected were analyzed for the parameters listed in Table 2-3.

Table 2-3. Laboratory Analyte List for Monitor Well Sampling

Parameter or Analyte	Total/Dissolved (1)	Method (2)	Reporting Limit (2)	Units
General Water Quality Parameters				
Alkalinity, Total (as $CaCO_3$)	Total	SM 2320B	2.0	mg/L
Bicarbonate (as $CaCO_3$)	Total	SM 2320B	2.0	mg/L
Carbonate (as $CaCO_3$)	Total	SM 2320B	2.0	mg/L
Chloride	Total	EPA 300.0	0.5	mg/L
Fluoride	Total	EPA 300.0	0.5	mg/L
Nitrate (as N)	Total	EPA 300.0	0.1	mg/L
Nitrite (as N)	Total	EPA 300.0	0.1	mg/L
Nitrate/Nitrite (as N)	Total	EPA 300.0, Calc.	0.1	mg/L
Sulfate	Total	EPA 300.0	0.5	mg/L
pH (lab)	Total	SM 4500B	0.1	s.u.
Total Dissolved Solids (TDS)	Dissolved	SM 2540C	10	mg/L
Total Organic Carbon (TOC)	Total	SM 5310B	1.0	mg/L
Metals/Metalloids				
Aluminum	Dissolved	EPA 200.7	0.05	mg/L
Antimony	Dissolved	EPA 200.8	0.002	mg/L
Arsenic	Dissolved	EPA 200.8	0.001	mg/L
Barium	Dissolved	EPA 200.8	0.001	mg/L
Beryllium	Dissolved	EPA 200.8	0.0005	mg/L
Boron	Dissolved	EPA 200.7	0.05	mg/L
Cadmium	Dissolved	EPA 200.8	0.001	mg/L
Calcium	Dissolved	EPA 200.7	0.1	mg/L
Chromium	Dissolved	EPA 200.8	0.002	mg/L
Cobalt	Dissolved	EPA 200.8	0.001	mg/L
Copper	Dissolved	EPA 200.8	0.001	mg/L
Iron	Dissolved	EPA 200.7	0.04	mg/L
Lead	Dissolved	EPA 200.8	0.001	mg/L
Lithium	Dissolved	EPA 200.8	0.002	mg/L
Magnesium	Dissolved	EPA 200.7	0.02	mg/L
Manganese	Dissolved	EPA 200.8	0.001	mg/L
Mercury	Dissolved	EPA 245.1	0.0002	mg/L
Molybdenum	Dissolved	EPA 200.8	0.002	mg/L

Table 2-3. Laboratory Analyte List for Monitor Well Sampling

Parameter or Analyte	Total/Dissolved (1)	Method (2)	Reporting Limit (2)	Units
Metals/Metalloids - Continued				
Nickel	Dissolved	EPA 200.8	0.002	mg/L
Phosphorus	Dissolved	EPA 200.7	0.04	mg/L
Potassium	Dissolved	EPA 200.7	0.5	mg/L
Selenium	Dissolved	EPA 200.8	0.002	mg/L
Silica	Dissolved	EPA 200.7	0.05	mg/L
Silver	Dissolved	EPA 200.8	0.001	mg/L
Sodium	Dissolved	EPA 200.7	0.5	mg/L
Strontium	Dissolved	EPA 200.7	0.02	mg/L
Thallium	Dissolved	EPA 200.8	0.001	mg/L
Tin	Dissolved	EPA 200.7	0.1	mg/L
Titanium	Dissolved	EPA 200.7	0.005	mg/L
Uranium, Total	Dissolved	EPA 200.8	0.001	mg/L
Vanadium	Dissolved	EPA 200.8	0.002	mg/L
Zinc	Dissolved	EPA 200.8	0.01	mg/L
Radiochemicals				
Gross Alpha	Dissolved	EPA 900.0	1.0	pCi/L
Gross Beta	Dissolved	EPA 900.0	1.0	pCi/L
Radium-226	Dissolved	EPA 903.0	1.0	pCi/L
Radium-228	Dissolved	EPA 904.0	1.0	pCi/L
Thorium-228	Dissolved	HASL 300	1.0	pCi/L
Thorium-230	Dissolved	HASL 300	1.0	pCi/L

Notes: (1) Dissolved constituents are field filtered with a new disposable 0.45 µm filter.
(2) EPA laboratory analytical methods and reporting limits are consistent with those provided in the QAPP Rev. 5 (ESI and Brown and Caldwell, 2009).
s.u. is "standard units" for pH
mg/L is "milligrams per liter"
pCi/L is "picocuries per liter"

SECTION 3.0
1Q 2011 MONITORING RESULTS

Results of 1Q 2011 GMR monitoring activities are summarized in this section. Field forms, field log books, and laboratory reports and data verification/validation reports are provided in Appendices F, G, and H, respectively. Monthly water levels were measured on January 24-26, March 1-3, and March 28-31, 2011. Water level data for the pit lake and an associated hydrograph are presented in Appendix I. Major ion chemical data are shown on Stiff diagrams (Plates) in Appendix J.

3.1 1Q 2011 Groundwater Level Monitoring Results

Groundwater level measurements and associated elevation data are summarized in Table 3-1. Water levels in some new wells were not available in January 2011 because these well were not installed or developed at that time. The relative change in groundwater elevation for the quarter is represented by a "+" if the groundwater level has risen by more than 0.5 feet, a "-" if it has dropped by more than 0.5 feet, and an "=" if it has changed by less than 0.5 feet, as measured by the last month of the previous quarter (December 2010) and the last month of the current quarter (March 2011). For some of the new monitor wells, the relative change is based on the difference between the January or February 2011 measurement, and the March 2011 measurement.

In general, groundwater levels in the shallow aquifer remained level in 72 wells, increased in 23 wells, and decreased in one well (B/W-27S) over the three months of 1Q 2011. Groundwater was not detected in ST-A. The monthly water levels measured in B/W-53S and USGS-13S were below the screen bottom. Groundwater levels in the intermediate aquifer have remained relatively stable in 26 wells, increased in 14 wells, and decreased in one well (B/W-5I). In the deep aquifer, water levels have remained relatively stable in 55 wells, increased in 17 wells, and decreased in one well (B/W-62D2). Water levels in the bedrock aquifer remained relatively stable in 16 wells, increased in nine wells, and decreased in one well (B/W-23B). Groundwater levels were not measured in WW-36B due to in-place pumping equipment.

Table 3-1. 1Q 2011 Monthly Water Levels

Location Name	Month (1)	Depth to Water ft bmp	Water Elevation ft amsl	Δ Previous Month ft	Relative Change (2)	Location Name	Month (1)	Depth to Water ft bmp	Water Elevation ft amsl	Δ Previous Month ft	Relative Change (2)
Shallow Zone											
B/W-1S	January	23.67	4333.93	0.04		B-3S	January	22.25	4334.39	-0.07	
	February	23.65	4333.95	0.02			February	22.32	4334.32	-0.07	
	March	23.61	4333.99	0.04	=		March	22.37	4334.27	-0.05	=
B/W-3S	January	26.27	4327.10	0.18		D4BC-1S	January	18.97	4333.97	-0.08	
	February	26.01	4327.36	0.26			February	19.00	4333.94	-0.03	
	March	25.84	4327.53	0.17	+		March	18.67	4334.27	0.33	=
B/W-4S	January	58.80	4326.07	0.38		D5AC-1S	January	28.96	4333.76	-0.12	
	February	58.30	4326.57	0.50			February	29.05	4333.67	-0.09	
	March	58.08	4326.79	0.22	+		March	29.08	4333.64	-0.03	=
B/W-5RS	January	32.61	4326.56	0.14		LC-MW-1S	January	23.78	4331.92	-1.16	
	February	32.37	4326.80	0.24			February	23.80	4331.90	-0.02	
	March	32.21	4326.96	0.16	+		March	21.97	4333.73	1.83	+
B/W-6S	January	106.28	4328.61	0.07		LC-MW-2S	January	15.57	4332.93	-0.05	
	February	106.12	4328.77	0.16			February	15.58	4332.92	-0.01	
	March	106.06	4328.83	0.06	=		March	15.20	4333.30	0.38	=
B/W-8S	January	143.58	4325.19	0.40		LC-MW-3S	January	15.84	4332.76	-0.22	
	February	143.00	4325.77	0.58			February	15.99	4332.61	-0.15	
	March	142.72	4326.05	0.28	+		March	14.62	4333.98	1.37	+
B/W-9S	January	22.50	4332.12	-0.05		LC-MW-5S	January	17.47	4330.73	-0.17	
	February	22.60	4332.02	-0.10			February	17.50	4330.70	-0.03	
	March	22.60	4332.02	0.00	=		March	16.73	4331.47	0.77	+
B/W-10S	January	23.55	4320.89	0.70		LEP-MW-1S	January	39.83	4328.77	0.18	
	February	23.30	4321.14	0.25			February	39.67	4328.93	0.16	
	March	23.04	4321.40	0.26	+		March	39.58	4329.02	0.09	=
B/W-11S	January	40.86	4330.20	-0.09		LEP-MW-2S	January	33.97	4328.53	0.14	
	February	40.73	4330.33	0.13			February	33.77	4328.73	0.20	
	March	40.64	4330.42	0.09	=		March	33.67	4328.83	0.10	=
B/W-13S	January	126.14	4379.72	0.68		LEP-MW-3S	January	26.20	4328.40	0.15	
	February	125.31	4380.55	0.83			February	26.02	4328.58	0.18	
	March	124.97	4380.89	0.34	+		March	25.95	4328.65	0.07	=
B/W-14S	January	13.62	4382.94	0.18		LEP-MW-5S	January	23.76	4329.84	0.03	
	February	13.30	4383.26	0.32			February	23.72	4329.88	0.04	
	March	12.28	4384.28	1.02	+		March	23.73	4329.87	-0.01	=

Table 3-1. 1Q 2011 Monthly Water Levels

Location Name	Month [(1)]	Depth to Water ft bmp	Water Elevation ft amsl	Δ Previous Month ft	Relative Change [(2)]	Location Name	Month [(1)]	Depth to Water ft bmp	Water Elevation ft amsl	Δ Previous Month ft	Relative Change [(2)]
Shallow Zone - Continued											
B/W-15S	January	10.91	4375.85	-0.07		LEP-MW-6S	January	21.85	4332.75	-0.03	
	February	10.63	4376.13	0.28			February	21.91	4332.69	-0.06	
	March	9.60	4377.16	1.03	+		March	21.94	4332.66	-0.03	=
B/W-16S	January	194.11	4327.58	-0.18		LEP-MW-7S	January	20.63	4333.47	0.26	
	February	193.90	4327.79	0.21			February	21.01	4333.09	-0.38	
	March	193.82	4327.87	0.08	=		March	21.01	4333.09	0.00	=
B/W-18S	January	23.77	4328.01	0.09		MW-2S	January	59.93	4334.66	1.17	
	February	23.50	4328.28	0.27			February	60.08	4334.51	-0.15	
	March	23.51	4328.27	-0.01	=		March	60.83	4333.76	-0.75	=
B/W-19S	January	99.04	4325.60	0.28		MW-4S	January	82.05	4329.88	0.09	
	February	98.52	4326.12	0.52			February	81.82	4330.11	0.23	
	March	98.25	4326.39	0.27	+		March	81.70	4330.23	0.12	=
B/W-20S	January	31.79	4383.30	0.45		MW-5S	January	52.11	4330.79	0.06	
	February	31.26	4383.83	0.53			February	51.74	4331.16	0.37	
	March	30.71	4384.38	0.55	+		March	51.94	4330.96	-0.20	=
B/W-21S	January	53.86	4351.90	0.25		MW2002-1S	January	20.08	4331.11	0.01	
	February	53.19	4352.57	0.67			February	20.10	4331.09	-0.02	
	March	52.37	4353.39	0.82	+		March	20.09	4331.10	0.01	=
B/W-22S	January	157.18	4329.93	0.03		MW2002-2S	January	47.46	4328.67	0.14	
	February	156.98	4330.13	0.20			February	47.26	4328.87	0.20	
	March	156.94	4330.17	0.04	=		March	47.15	4328.98	0.11	=
B/W-25S	January	21.42	4333.55	-0.02		PW10-P1[(3)]	January	38.73	4329.36	0.05	
	February	21.45	4333.52	-0.03			February	38.60	4329.49	0.13	
	March	21.20	4333.77	0.25	=		March	38.58	4329.51	0.02	=
B/W-27S	January	19.85	4338.02	-0.39		PA-MW-1S	January	99.57	4341.47	-0.11	
	February	20.15	4337.72	-0.30			February	99.53	4341.51	0.04	
	March	20.34	4337.53	-0.19	-		March	99.55	4341.49	-0.02	=
B/W-28S	January	49.55	4325.48	0.43		PA-MW-2S	January	145.48	4338.90	-0.02	
	February	49.10	4325.93	0.45			February	145.42	4338.96	0.06	
	March	48.87	4326.16	0.23	+		March	145.41	4338.97	0.01	=
B/W-29S	January	79.06	4334.13	0.10		PA-MW-3S	January	119.75	4340.42	-0.07	
	February	78.95	4334.24	0.11			February	119.73	4340.44	0.02	
	March	78.85	4334.34	0.10	=		March	119.79	4340.38	-0.06	=

Table 3-1. 1Q 2011 Monthly Water Levels

Location Name	Month (1)	Depth to Water ft bmp	Water Elevation ft amsl	Δ Previous Month ft	Relative Change (2)	Location Name	Month (1)	Depth to Water ft bmp	Water Elevation ft amsl	Δ Previous Month ft	Relative Change (2)
Shallow Zone - Continued											
B/W-30S	January	18.42	4328.88	0.12		ST-A (4)	January	NA	NA	NA	
	February	18.30	4329.00	0.12			February	NA	NA	NA	
	March	17.63	4329.67	0.67	+		March	Dry	NA	NA	NA
B/W-31S1(5)	January	18.32	4330.38	NA		USEPA2S	January	19.33	4338.89	0.05	
	February	18.19	4330.51	0.13			February	19.55	4338.67	-0.22	
	March	18.02	4330.68	0.17	=		March	19.61	4338.61	-0.06	=
B/W-31S2(5)	January	18.21	4330.69	NA		USGS-2BS	January	19.92	4334.40	-0.10	
	February	17.51	4331.39	0.70			February	19.20	4335.12	0.72	
	March	18.06	4330.84	-0.55	=		March	20.00	4334.32	-0.80	=
B/W-32S(5)	January	24.45	4327.05	NA		USGS-13S(7)	January	18.05	4331.17	-0.02	
	February	24.31	4327.19	0.14			February	18.96	4330.26	-0.91	
	March	24.38	4327.12	-0.07	=		March	18.05	4331.17	0.91	=
B/W-33S	January	110.39	4327.71	0.07		UW-1S	January	107.79	4336.04	0.17	
	February	110.21	4327.89	0.18			February	107.79	4336.04	0.00	
	March	110.14	4327.96	0.07	=		March	107.91	4335.92	-0.12	=
B/W-34S(5)	January	76.66	4329.64	NA		W5AA-2S	January	18.71	4333.75	-0.04	
	February	76.44	4329.86	0.22			February	18.79	4333.67	-0.08	
	March	76.42	4329.88	0.02	=		March	18.75	4333.71	0.04	=
B/W-36S	January	95.01	4334.79	0.34		W5AA-3S(8)	January	NA	NA	NA	
	February	94.80	4335.00	0.21			February	23.20	4333.69	NA	
	March	95.55	4334.25	-0.75	=		March	23.19	4333.70	0.01	=
B/W-37S	January	82.20	4334.30	0.36		W5AB-2S	January	19.12	4331.78	-0.01	
	February	81.93	4334.57	0.27			February	19.21	4331.69	-0.09	
	March	82.22	4334.28	-0.29	=		March	19.19	4331.71	0.02	=
B/W-38RS(5)	January	80.01	4334.89	NA		W5AD-1S	January	33.79	4334.35	-0.10	
	February	79.72	4335.18	0.29			February	33.83	4334.31	-0.04	
	March	79.79	4335.11	-0.07	=		March	33.84	4334.30	-0.01	=
B/W-40S(6)	January	NA	NA	NA		W5BB-S	January	27.84	4328.09	0.13	
	February	176.45	4328.30	NA			February	27.63	4328.30	0.21	
	March	176.37	4328.38	0.08	=		March	27.55	4328.38	0.08	=
B/W-41S(6)	January	NA	NA	NA		W5DB-S(6)	January	NA	NA	NA	
	February	53.90	4327.24	NA			February	33.25	4334.15	NA	
	March	53.75	4327.39	0.15	=		March	33.30	4334.10	-0.05	=

Table 3-1. 1Q 2011 Monthly Water Levels

Location Name	Month [1]	Depth to Water ft bmp	Water Elevation ft amsl	Δ Previous Month ft	Relative Change [2]	Location Name	Month [1]	Depth to Water ft bmp	Water Elevation ft amsl	Δ Previous Month ft	Relative Change [2]
Shallow Zone - Continued											
B/W-42S	January	21.57	4329.13	NA		WRP-1S	January	8.30	4385.50	0.10	
	February	21.48	4329.22	0.09			February	7.94	4385.86	0.36	
	March	21.37	4329.33	0.11	=		March	5.61	4388.19	2.33	+
B/W-43S[6]	January	NA	NA	NA		WRP-2S	January	11.05	4382.00	0.08	
	February	17.45	4333.65	NA			February	10.65	4382.40	0.40	
	March	17.38	4333.72	0.07	=		March	8.35	4384.70	2.30	+
B/W-44S	January	41.96	4329.64	0.15		WW-1S	January	41.11	4368.80	0.20	
	February	41.74	4329.86	0.22			February	40.88	4369.03	0.23	
	March	41.70	4329.90	0.04	=		March	40.63	4369.28	0.25	+
B/W-45S[5]	January	43.85	4325.60	NA		WW-2S	January	43.01	4364.06	0.17	
	February	42.95	4326.50	0.90			February	42.81	4364.26	0.20	
	March	42.73	4326.72	0.22	+		March	42.59	4364.48	0.22	+
B/W-46S[6]	January	NA	NA	NA		PW-1S	January	27.25	4334.10	-0.06	
	February	32.00	4327.64	NA			February	27.40	4333.95	-0.15	
	March	31.74	4327.90	0.26	=		March	27.04	4334.31	0.36	=
B/W-52S	January	30.34	4325.46	0.16		PW-2S	January	33.61	4334.28	-0.11	
	February	30.06	4325.74	0.28			February	33.66	4334.23	-0.05	
	March	29.77	4326.03	0.29	+		March	33.58	4334.31	0.08	=
B/W-53S[5, 7]	January	109.40	4290.03	NA		PW-3S	January	37.60	4334.49	-0.11	
	February	109.31	4290.12	0.09			February	37.61	4334.48	-0.01	
	March	109.31	4290.12	0.00	=		March	37.68	4334.41	-0.07	=
B/W-55S[5]	January	15.69	4328.21	NA		PW-4S	January	32.51	4334.40	-0.15	
	February	15.52	4328.38	0.17			February	32.63	4334.28	-0.12	
	March	15.13	4328.77	0.39	+		March	32.63	4334.28	0.00	=
B/W-60S[5]	January	25.75	4334.55	NA		PW-5S	January	34.41	4334.35	-0.12	
	February	25.55	4334.75	0.20			February	34.51	4334.25	-0.10	
	March	25.44	4334.86	0.11	=		March	34.50	4334.26	0.01	=
B/W-61S	January	25.90	4334.00	0.01		PW-6S	January	35.32	4333.25	-0.11	
	February	25.83	4334.07	0.07			February	35.36	4333.21	-0.04	
	March	25.72	4334.18	0.11	=		March	35.41	4333.16	-0.05	=
B/W-62S	January	22.74	4333.86	-0.08		PW-7S	January	33.34	4333.10	-0.11	
	February	22.78	4333.82	-0.04			February	33.38	4333.06	-0.04	
	March	22.55	4334.05	0.23	=		March	33.42	4333.02	-0.04	=

Table 3-1. 1Q 2011 Monthly Water Levels

Location Name	Month (1)	Depth to Water ft bmp	Water Elevation ft amsl	Δ Previous Month ft	Relative Change (2)	Location Name	Month (1)	Depth to Water ft bmp	Water Elevation ft amsl	Δ Previous Month ft	Relative Change (2)
Shallow Zone - Continued											
B/W-64S(5)	January	23.48	4338.72	NA		PW-8S	January	34.50	4332.29	-0.14	
	February	23.69	4338.51	-0.21			February	34.52	4332.27	-0.02	
	March	23.67	4338.53	0.02	=		March	34.53	4332.26	-0.01	=
B/W-65S	January	19.10	4333.80	-0.12		PW-9S	January	35.94	4331.05	-0.09	
	February	19.14	4333.76	-0.04			February	35.85	4331.14	0.09	
	March	19.03	4333.87	0.11	=		March	35.88	4331.11	-0.03	=
B/W-66S(5)	January	20.70	4330.90	NA		PW-10S	January	36.89	4329.37	-0.03	
	February	20.68	4330.92	0.02			February	36.73	4329.53	0.16	
	March	20.64	4330.96	0.04	=		March	36.68	4329.58	0.05	=
B/W-67S(6)	January	NA	NA	NA		PW-11S	January	40.79	4328.51	0.08	
	February	20.50	4331.30	NA			February	40.57	4328.73	0.22	
	March	20.47	4331.33	0.03	=		March	40.46	4328.84	0.11	=
B-2S	January	23.50	4334.26	-0.09							
	February	23.20	4334.56	0.30							
	March	23.50	4334.26	-0.30	=						
Intermediate Zone											
B/W-2I	January	21.30	4330.56	0.13		B/W-46I(6)	January	NA	NA	NA	
	February	21.22	4330.64	0.08			February	31.80	4327.52	NA	
	March	21.16	4330.70	0.06	=		March	31.53	4327.79	0.27	=
B/W-3I	January	26.50	4327.17	0.22		B/W-51I1	January	62.21	4324.29	0.51	
	February	26.27	4327.40	0.23			February	61.62	4324.88	0.59	
	March	26.04	4327.63	0.23	+		March	61.30	4325.20	0.32	+
B/W-4I	January	58.44	4326.16	0.44		B/W-51I2	January	62.04	4324.46	0.47	
	February	57.99	4326.61	0.45			February	61.49	4325.01	0.55	
	March	57.82	4326.78	0.17	+		March	61.19	4325.31	0.30	+
B/W-5RI	January	32.66	4326.61	0.13		B/W-52I	January	30.33	4325.37	0.24	
	February	32.41	4326.86	0.25			February	30.01	4325.69	0.32	
	March	32.26	4327.01	0.15	+		March	29.71	4325.99	0.30	+
B/W-6I	January	105.30	4328.71	0.02		B/W-53I(5)	January	120.45	4278.51	NA	
	February	105.10	4328.91	0.20			February	132.50	4266.46	-12.05	
	March	105.10	4328.91	0.00	=		March	117.18	4281.78	15.32	+

Table 3-1. 1Q 2011 Monthly Water Levels

Location Name	Month [1]	Depth to Water ft bmp	Water Elevation ft amsl	Δ Previous Month ft	Relative Change [2]	Location Name	Month [1]	Depth to Water ft bmp	Water Elevation ft amsl	Δ Previous Month ft	Relative Change [2]
Intermediate Zone - Continued											
B/W-7I	January	154.28	4326.93	0.03		B/W-54I1	January	41.05	4312.05	2.29	
	February	154.27	4326.94	0.01			February	40.26	4312.84	0.79	
	March	153.87	4327.34	0.40	=		March	39.72	4313.38	0.54	+
B/W-8I	January	143.25	4325.08	0.22		B/W-54I2[5]	January	42.63	4310.27	NA	
	February	142.65	4325.68	0.60			February	41.80	4311.10	0.83	
	March	142.42	4325.91	0.23	+		March	41.24	4311.66	0.56	+
B/W-9I	January	22.24	4332.05	-0.03		B/W-65I	January	19.53	4333.57	-0.06	
	February	22.27	4332.02	-0.03			February	19.55	4333.55	-0.02	
	March	22.21	4332.08	0.06	=		March	19.49	4333.61	0.06	=
B/W-19I	January	98.90	4325.68	0.27		B/W-66I[5]	January	20.60	4331.00	NA	
	February	98.40	4326.18	0.50			February	20.57	4331.03	0.03	
	March	98.15	4326.43	0.25	+		March	20.51	4331.09	0.06	=
B/W-27I	January	21.93	4335.27	-0.03		B/W-67I[6]	January	NA	NA	NA	
	February	22.02	4335.18	-0.09			February	20.96	4330.96	NA	
	March	21.97	4335.23	0.05	=		March	20.82	4331.10	0.14	=
B/W-28I	January	49.95	4325.46	0.39		LEP-MW-4I	January	25.70	4329.40	0.14	
	February	49.47	4325.94	0.48			February	25.55	4329.55	0.15	
	March	49.26	4326.15	0.21	+		March	25.45	4329.65	0.10	=
B/W-29I	January	77.98	4334.96	1.06		LEP-MW-8I	January	20.51	4333.09	0.03	
	February	78.80	4334.14	-0.82			February	20.55	4333.05	-0.04	
	March	78.75	4334.19	0.05	=		March	20.38	4333.22	0.17	=
B/W-30I[5]	January	18.55	4328.65	NA		LEP-MW-9I	January	20.57	4333.33	0.02	
	February	18.36	4328.84	0.19			February	20.54	4333.36	0.03	
	March	17.96	4329.24	0.40	+		March	20.38	4333.52	0.16	=
B/W-31I[5]	January	18.72	4330.38	NA		MW-4I	January	82.82	4329.88	0.09	
	February	18.63	4330.47	0.09			February	82.62	4330.08	0.20	
	March	18.41	4330.69	0.22	=		March	82.50	4330.20	0.12	=
B/W-32I[5]	January	23.00	4328.52	NA		MW-5I[6]	January	NA	NA	NA	
	February	22.84	4328.68	0.16			February	50.56	4331.68	NA	
	March	22.74	4328.78	0.10	=		March	51.13	4331.11	-0.57	-
B/W-33I	January	110.10	4327.80	0.11		W4CB-1I	January	22.42	4333.47	0.04	
	February	109.94	4327.96	0.16			February	22.38	4333.51	0.04	
	March	109.85	4328.05	0.09	=		March	21.75	4334.14	0.63	+

Table 3-1. 1Q 2011 Monthly Water Levels

Location Name	Month [1]	Depth to Water ft bmp	Water Elevation ft amsl	Δ Previous Month ft	Relative Change [2]	Location Name	Month [1]	Depth to Water ft bmp	Water Elevation ft amsl	Δ Previous Month ft	Relative Change [2]
Intermediate Zone - Continued											
B/W-34I[5]	January	77.17	4329.63	NA		W4CB-2I	January	23.49	4332.61	-0.95	
	February	76.97	4329.83	0.20			February	22.46	4333.64	1.03	
	March	76.87	4329.93	0.10	=		March	22.32	4333.78	0.14	=
B/W-37I	January	82.30	4334.30	0.28		W5AA-1I	January	18.68	4333.07	0.02	
	February	82.10	4334.50	0.20			February	18.68	4333.07	0.00	
	March	82.24	4334.36	-0.14	=		March	18.53	4333.22	0.15	=
B/W-38RI[5]	January	79.52	4334.88	NA		W5AB-3I	January	20.35	4331.12	0.06	
	February	79.22	4335.18	0.30			February	20.30	4331.17	0.05	
	March	79.29	4335.11	-0.07	=		March	20.26	4331.21	0.04	=
B/W-41I[6]	January	NA	NA	NA		W5DB-I	January	35.11	4332.09	0.10	
	February	53.80	4327.23	NA			February	34.97	4332.23	0.14	
	March	53.63	4327.40	0.17	=		March	34.90	4332.30	0.07	=
B/W-42I	January	21.60	4329.00	0.11							
	February	21.40	4329.20	0.20							
	March	21.24	4329.36	0.16	=						
Deep Zone											
B/W-1D1	January	25.25	4332.51	-0.39		B/W-44D2	January	41.65	4329.75	0.14	
	February	24.82	4332.94	0.43			February	41.44	4329.96	0.21	
	March	24.60	4333.16	0.22	=		March	41.40	4330.00	0.04	=
B/W-1D2	January	25.88	4331.74	-0.03		B/W-45D1[5]	January	43.78	4325.60	NA	
	February	25.66	4331.96	0.22			February	42.87	4326.51	0.91	
	March	25.48	4332.14	0.18	=		March	42.62	4326.76	0.25	+
B/W-1D3	January	26.36	4330.96	0.00		B/W-45D2[5]	January	43.52	4326.33	NA	
	February	26.06	4331.26	0.30			February	43.13	4326.72	0.39	
	March	25.96	4331.36	0.10	=		March	42.92	4326.93	0.21	+
B/W-1D5[5]	January	26.32	4330.88	NA		B/W-46D1[6]	January	NA	NA	NA	
	February	26.08	4331.12	0.24			February	32.36	4327.08	NA	
	March	25.98	4331.22	0.10	=		March	32.15	4327.29	0.21	=
B/W-2D1	January	21.67	4329.72	0.27		B/W-52D2	January	30.60	4325.00	0.34	
	February	21.50	4329.89	0.17			February	30.19	4325.41	0.41	
	March	21.40	4329.99	0.10	+		March	29.96	4325.64	0.23	+

Table 3-1. 1Q 2011 Monthly Water Levels

Location Name	Month (1)	Depth to Water ft bmp	Water Elevation ft amsl	Δ Previous Month ft	Relative Change (2)	Location Name	Month (1)	Depth to Water ft bmp	Water Elevation ft amsl	Δ Previous Month ft	Relative Change (2)
Deep Zone - Continued											
B/W-2D3(6)	January	NA	NA	NA		B/W-55D1	January	16.50	4327.60	0.20	
	February	21.57	4329.74	NA			February	16.26	4327.84	0.24	
	March	21.50	4329.81	0.07	=		March	16.00	4328.10	0.26	+
B/W-2D4(6)	January	NA	NA	NA		B/W-55D2(5)	January	17.35	4326.75	NA	
	February	21.82	4330.09	NA			February	17.04	4327.06	0.31	
	March	21.73	4330.18	0.09	=		March	16.84	4327.26	0.20	+
B/W-3D1	January	26.25	4327.45	0.29		B/W-60D1(5)	January	25.94	4334.26	NA	
	February	25.92	4327.78	0.33			February	25.73	4334.47	0.21	
	March	25.75	4327.95	0.17	+		March	25.74	4334.46	-0.01	=
B/W-4D1	January	57.97	4325.99	0.44		B/W-60D3	January	29.05	4331.25	0.01	
	February	57.50	4326.46	0.47			February	28.66	4331.64	0.39	
	March	57.29	4326.67	0.21	+		March	28.79	4331.51	-0.13	=
B/W-5RD1	January	32.46	4326.88	0.11		B/W-60D5(5)	January	28.95	4331.25	NA	
	February	32.20	4327.14	0.26			February	28.72	4331.48	0.23	
	March	32.07	4327.27	0.13	+		March	28.68	4331.52	0.04	=
B/W-9D2	January	23.25	4330.59	0.15		B/W-61D1	January	25.98	4333.62	0.04	
	February	23.07	4330.77	0.18			February	25.85	4333.75	0.13	
	March	22.95	4330.89	0.12	=		March	25.75	4333.85	0.10	=
B/W-10D1	January	23.33	4320.75	0.48		B/W-61D3	January	26.56	4332.84	2.15	
	February	22.80	4321.28	0.53			February	28.32	4331.08	-1.76	
	March	22.57	4321.51	0.23	+		March	28.25	4331.15	0.07	=
B/W-11D2	January	40.75	4329.85	0.24		B/W-62D1(5)	January	23.56	4332.74	NA	
	February	40.60	4330.00	0.15			February	23.34	4332.96	0.22	
	March	40.53	4330.07	0.07	=		March	23.32	4332.98	0.02	=
B/W-18D1	January	22.88	4328.61	0.12		B/W-62D2(5)	January	23.33	4333.07	NA	
	February	22.66	4328.83	0.22			February	24.12	4332.28	-0.79	
	March	22.57	4328.92	0.09	=		March	24.13	4332.27	-0.01	-
B/W-18D2	January	23.27	4328.56	0.09		B/W-62D4(5)	January	25.55	4330.75	NA	
	February	23.06	4328.77	0.21			February	25.25	4331.05	0.30	
	March	22.94	4328.89	0.12	=		March	25.20	4331.10	0.05	=
B/W-19D1	January	98.10	4325.88	0.26		B/W-62D5(5)	January	26.02	4330.77		
	February	97.57	4326.41	0.53			February	25.64	4331.15	0.38	
	March	97.34	4326.64	0.23	+		March	25.55	4331.24	0.09	=

Table 3-1. 1Q 2011 Monthly Water Levels

Location Name	Month (1)	Depth to Water ft bmp	Water Elevation ft amsl	Δ Previous Month ft	Relative Change (2)	Location Name	Month (1)	Depth to Water ft bmp	Water Elevation ft amsl	Δ Previous Month ft	Relative Change (2)
Deep Zone - Continued											
B/W-25D1	January	21.97	4333.03	0.06		B/W-64D1(5)	January	26.71	4335.69	NA	
	February	21.95	4333.05	0.02			February	26.70	4335.70	0.01	
	March	21.80	4333.20	0.15	=		March	26.63	4335.77	0.07	=
B/W-25D2	January	22.71	4331.92	0.14		B/W-64D2	January	29.08	4333.22	0.14	
	February	22.62	4332.01	0.09			February	29.00	4333.30	0.08	
	March	22.49	4332.14	0.13	=		March	29.00	4333.30	0.00	=
B/W-27D3a	January	26.66	4330.92	0.18		B/W-65D1	January	20.58	4332.52	0.05	
	February	26.50	4331.08	0.16			February	20.48	4332.62	0.10	
	March	26.40	4331.18	0.10	=		March	20.36	4332.74	0.12	=
B/W-27D3b(5)	January	28.45	4328.95	NA		B/W-65D5	January	23.40	4329.80	0.25	
	February	28.16	4329.24	0.29			February	23.10	4330.10	0.30	
	March	28.10	4329.30	0.06	=		March	23.03	4330.17	0.07	+
B/W-28D1	January	48.64	4325.56	0.39		B/W-66D1(5)	January	21.50	4330.00	NA	
	February	48.22	4325.98	0.42			February	21.31	4330.19	0.19	
	March	48.00	4326.20	0.22	+		March	21.21	4330.29	0.10	=
B/W-29D1	January	80.05	4333.19	0.15		B/W-66D5(5)	January	22.91	4328.99	NA	
	February	79.90	4333.34	0.15			February	22.70	4329.20	0.21	
	March	79.92	4333.32	-0.02	=		March	22.61	4329.29	0.09	=
B/W-29D3	January	80.85	4332.12	0.20		B/W-67D1(6)	January	NA	NA	NA	
	February	80.65	4332.32	0.20			February	20.75	4330.97	NA	
	March	80.70	4332.27	-0.05	=		March	20.61	4331.11	0.14	=
B/W-30D1(5)	January	19.70	4327.90	NA		B/W-67D3(6)	January	NA	NA	NA	
	February	19.58	4328.02	0.12			February	22.44	4329.24	NA	
	March	19.20	4328.40	0.38	+		March	22.10	4329.58	0.34	=
B/W-31D2(5)	January	19.20	4329.40	NA		LEP-MW-2D1(5)	January	34.04	4328.66	NA	
	February	19.02	4329.58	0.18			February	33.88	4328.82	0.16	
	March	18.85	4329.75	0.17	=		March	33.79	4328.91	0.09	=
B/W-32D2(6)	January	NA	NA	NA		LEP-MW-2D3(5)	January	34.18	4328.62	NA	
	February	22.53	4328.65	NA			February	33.98	4328.82	0.20	
	March	22.42	4328.76	0.11	=		March	33.91	4328.89	0.07	=

Table 3-1. 1Q 2011 Monthly Water Levels

Location Name	Month (1)	Depth to Water ft bmp	Water Elevation ft amsl	Δ Previous Month ft	Relative Change (2)	Location Name	Month (1)	Depth to Water ft bmp	Water Elevation ft amsl	Δ Previous Month ft	Relative Change (2)
Deep Zone - Continued											
B/W-32D5(6)	January	NA	NA	NA		MW-5D2(6)	January	NA	NA	NA	
	February	22.19	4328.86	NA			February	49.90	4332.18	NA	
	March	22.13	4328.92	0.06	=		March	50.09	4331.99	-0.19	=
B/W-33D1	January	109.52	4327.78	0.06		MW-5D3(6)	January	NA	NA	NA	
	February	109.37	4327.93	0.15			February	50.50	4331.24	NA	
	March	109.29	4328.01	0.08	=		March	50.21	4331.53	0.29	=
B/W-34D1(6)	January	NA	NA	NA		MW2002-2D1	January	48.47	4328.81	0.16	
	February	76.79	4328.11	NA			February	48.28	4329.00	0.19	
	March	76.70	4328.20	0.09	=		March	48.18	4329.10	0.10	=
B/W-37D1	January	82.20	4334.20	0.29		W32DC-D1	January	19.58	4329.57	0.17	
	February	81.94	4334.46	0.26			February	19.40	4329.75	0.18	
	March	82.02	4334.38	-0.08	=		March	19.32	4329.83	0.08	=
B/W-38RD1(5)	January	79.48	4335.02	NA		W4CB-2D1	January	24.85	4333.25	0.13	
	February	79.13	4335.37	0.35			February	24.77	4333.33	0.08	
	March	79.25	4335.25	-0.12	=		March	24.89	4333.21	-0.12	=
B/W-40D1(6)	January	NA	NA	NA		W4CB-2D3	January	26.77	4331.33	0.15	
	February	176.10	4329.04	NA			February	26.55	4331.55	0.22	
	March	176.04	4329.10	0.06	=		March	26.55	4331.55	0.00	=
B/W-40D3(5)	January	175.62	4328.51	NA		W4CB-2D4(5)	January	26.86	4331.14	NA	
	February	175.50	4328.63	0.12			February	26.62	4331.38	0.24	
	March	175.49	4328.64	0.01	=		March	26.59	4331.41	0.03	=
B/W-41D2(6)	January	NA	NA	NA		W5DB-D1	January	33.40	4331.54	0.16	
	February	53.53	4327.44	NA			February	33.30	4331.64	0.10	
	March	53.40	4327.57	0.13	=		March	33.25	4331.69	0.05	=
B/W-41D4(6)	January	NA	NA	NA		W5DB-D3	January	36.78	4330.62	0.17	
	February	55.10	4325.88	NA			February	36.53	4330.87	0.25	
	March	54.44	4326.54	0.66	+		March	36.46	4330.94	0.07	=

Table 3-1. 1Q 2011 Monthly Water Levels

Location Name	Month (1)	Depth to Water ft bmp	Water Elevation ft amsl	Δ Previous Month ft	Relative Change (2)	Location Name	Month (1)	Depth to Water ft bmp	Water Elevation ft amsl	Δ Previous Month ft	Relative Change (2)
Deep Zone - Continued											
B/W-42D1	January	22.60	4328.10	0.20		W5DB-D4	January	36.40	4331.10	0.18	
	February	22.38	4328.32	0.22			February	36.15	4331.35	0.25	
	March	22.10	4328.60	0.28	+		March	36.08	4331.42	0.07	+
B/W-44D1	January	41.65	4329.85	0.15							
	February	41.44	4330.06	0.21							
	March	41.40	4330.10	0.04	=						
Bedrock Zone											
B/W-1B(6)	January	32.83	4324.57	0.20		B/W-51B	January	61.91	4324.59	0.52	
	February	32.07	4325.33	0.76			February	61.36	4325.14	0.55	
	March	31.82	4325.58	0.25	+		March	61.08	4325.42	0.28	+
B/W-2B(6)	January	NA	NA	NA		B/W-53B(5)	January	120.28	4278.58	NA	
	February	21.62	4330.22	NA			February	131.24	4267.62	-10.96	
	March	21.53	4330.31	0.09	=		March	117.02	4281.84	14.22	+
B/W-6B(6)	January	NA	NA	NA		B/W-54B	January	42.26	4310.14	0.67	
	February	105.70	4329.06	NA			February	41.42	4310.98	0.84	
	March	105.75	4329.01	-0.05	=		March	40.85	4311.55	0.57	+
B/W-11B	January	40.03	4330.91	-0.11		B/W-61B	January	32.97	4326.63	0.87	
	February	39.88	4331.06	0.15			February	32.71	4326.89	0.26	
	March	39.80	4331.14	0.08	=		March	32.41	4327.19	0.30	+
B/W-22B	January	158.16	4330.34	0.07		B/W-62B(5)	January	26.67	4330.51	NA	
	February	158.02	4330.48	0.14			February	26.29	4330.89	0.38	
	March	157.95	4330.55	0.07	=		March	26.18	4331.00	0.11	=
B/W-23B	January	228.28	4416.93	-0.67		B/W-64B(5)	January	29.80	4332.60	NA	
	February	226.50	4418.71	1.78			February	29.67	4332.73	0.13	
	March	228.40	4416.81	-1.90	-		March	29.70	4332.70	-0.03	=
B/W-33B	January	109.21	4327.79	0.10		LEP-MW-2B(5)	January	34.84	4328.66	NA	
	February	109.02	4327.98	0.19			February	34.64	4328.86	0.20	
	March	109.03	4327.97	-0.01	=		March	34.50	4329.00	0.14	=

Table 3-1. 1Q 2011 Monthly Water Levels

Location Name	Month [1]	Depth to Water (ft bmp)	Water Elevation (ft amsl)	Δ Previous Month (ft)	Relative Change [2]	Location Name	Month [1]	Depth to Water (ft bmp)	Water Elevation (ft amsl)	Δ Previous Month (ft)	Relative Change [2]
Bedrock Zone - Continued											
B/W-34B[5]	January	76.65	4329.85	NA		MW-4B	January	82.80	4330.00	0.10	
	February	76.44	4330.06	0.21			February	82.65	4330.15	0.15	
	March	76.35	4330.15	0.09	=		March	82.46	4330.34	0.19	=
B/W-36B	January	94.69	4334.81	0.27		MW-5B[6]	January	NA	NA	NA	
	February	94.54	4334.96	0.15			February	49.69	4332.20	NA	
	March	94.63	4334.87	-0.09	=		March	49.78	4332.11	-0.09	=
B/W-37B	January	80.65	4335.75	0.21		W4CB-2B	January	31.81	4326.29	0.77	
	February	80.45	4335.95	0.20			February	31.34	4326.76	0.47	
	March	80.53	4335.87	-0.08	=		March	31.15	4326.95	0.19	+
B/W-38RB	January	79.51	4335.09	0.19		W5DB-B[6]	January	NA	NA	NA	
	February	79.20	4335.40	0.31			February	240.15	4127.85	NA	
	March	79.27	4335.33	-0.07	=		March	144.63	4223.37	95.52	+
B/W-39B	January	42.72	4355.78	0.36		WW-40B	January	66.15	4351.52	0.92	
	February	42.52	4355.98	0.20			February	65.89	4351.78	0.26	
	March	42.41	4356.09	0.11	+		March	65.07	4352.60	0.82	+
B/W-44B	January	41.36	4329.84	0.16		WW-59B	January	208.88	4312.04	-0.18	
	February	41.14	4330.06	0.22			February	208.98	4311.94	-0.10	
	March	41.09	4330.11	0.05	=		March	208.74	4312.18	0.24	=

Notes:
(1) Water levels measured January 24-26, March 1-3 and March 14, and March 28-31, 2011, respectively.
(2) Relative change represents whether water level is rising, falling, or relatively stable over the 3 month period.
(3) As of April 2010, piezometer P-1S has been redesignated as PW10-P1.
(4) Water levels for ST-A not measured until March 2011; well "dry".
(5) Began monitoring water levels January 2011.
(6) Began monitoring water levels February 2011.
(7) Water level below bottom of well screen (B/W-53S and USGS-13S).
(8) Manual water level for W5AA-3S not detected in January 2011.
NA - Not available, measurement not recorded
ft - feet; ft bmp - feet below measuring point

Hydrographs based on manual measurements and electronic data are presented in Appendix B-1 and B-2, respectively. Each hydrograph presents data from a specific well/piezometer or cluster of wells/piezometers. Hydrographs of vertical gradients based on manual water levels for each well cluster are presented in Appendix B-3. Monthly potentiometric surface maps based on manual water level data from wells with screen intervals in the shallow, intermediate and deep zones of the alluvial aquifer, and for bedrock wells, are presented in Appendix B-4. All groundwater elevation data (including pressure transducer data) are provided in Appendix C-3.

Vertical Gradients

Temporal vertical gradients for well clusters are presented in Appendix B-3. Table 3-2 summarizes manual head measurements, and calculated vertical gradients, for 71 select well pairs. A positive value for the calculated gradient represents a downward vertical flow gradient and a negative value represents an upward vertical flow gradient.

Table 3-2. 1Q 2011 Vertical Hydraulic Gradient Data

Location	Date	Shallow Well		Deep Well		Delta Head	Dist. Between Well Screen Midpoints	Calculated Gradient
		Well Name	Head (ft amsl)	Well Name	Head (ft amsl)	(feet)	(feet)	
BW-1	March 28, 2011	B/W-1S	4333.99	B/W-1D3	4331.36	2.63	300.98	0.01
BW-1	March 28, 2011	B/W-1S	4333.99	B/W-1D5	4331.22	2.77	452.20	0.01
BW-1	March 28, 2011	B/W-1D5	4331.22	B/W-1B	4325.58	5.64	177.60	0.03
BW-2	March 31, 2011	MW2002-1S	4331.10	B/W-2D1	4329.99	1.11	112.64	0.01
BW-2	March 31, 2011	MW2002-1S	4331.10	B/W-2D4	4330.17	0.93	397.68	0.00
BW-2	March 31, 2011	B/W-2D4	4330.17	B/W-2B	4330.31	-0.14	99.92	0.00
BW-3	March 30, 2011	B/W-3S	4327.53	B/W-3D1	4327.95	-0.42	108.70	0.00
BW-4	March 30, 2011	B/W-4S	4326.79	B/W-4D1	4326.67	0.12	88.70	0.00
BW-5	March 30, 2011	B/W-5RS	4326.96	B/W-5RD1	4327.27	-0.31	84.60	0.00
BW-6	March 30, 2011	B/W-6S	4328.83	B/W-6I	4328.91	-0.08	61.60	0.00
BW-6	March 30, 2011	B/W-6I	4328.91	B/W-6B	4329.0	-0.1	92.6	0.0
BW-8	March 30, 2011	B/W-8S	4326.05	B/W-8I	4325.91	0.14	41.70	0.00
BW-9	March 28, 2011	B/W-9S	4332.02	B/W-9D2	4330.89	1.13	124.90	0.01
BW-10	March 30, 2011	B/W-10S	4321.40	B/W-10D1	4321.51	-0.11	80.50	0.00
BW-11	March 31, 2011	B/W-11S	4330.42	B/W-11D2	4330.07	0.35	127.90	0.00

Table 3-2. 1Q 2011 Vertical Hydraulic Gradient Data

Location	Date	Shallow Well		Deep Well		Delta Head	Dist. Between Well Screen Midpoints	Calculated Gradient
		Well Name	Head (ft amsl)	Well Name	Head (ft amsl)	(feet)	(feet)	
BW-11	March 31, 2011	B/W-11D2	4330.07	B/W-11B	4331.14	-1.07	59.80	-0.02
BW-11	March 31, 2011	B/W-11S	4330.42	B/W-11B	4331.14	-1.41	59.80	-0.01
BW-18	March 30, 2011	B/W-18S	4328.27	B/W-18D2	4328.89	-0.62	129.65	0.00
BW-19	March 30, 2011	B/W-19S	4326.39	B/W-19D1	4326.64	-0.25	115.00	0.00
BW-22	March 30, 2011	B/W-22S	4330.17	B/W-22B	4330.55	-0.38	48.10	-0.01
BW-25	March 30, 2011	B/W-25S	4333.77	B/W-25D2	4332.14	1.63	188.80	0.01
BW-27	March 28, 2011	B/W-27S	4337.53	B/W-27D3a	4331.18	6.35	214.20	0.03
BW-27	March 28, 2011	B/W-27S	4337.53	B/W-27D3b	4329.30	8.23	316.00	0.03
BW-28	March 30, 2011	B/W-28S	4326.16	B/W-28D1	4326.20	-0.04	109.70	0.00
BW-29	March 30, 2011	B/W-29S	4334.34	B/W-29D3	4332.27	2.07	265.00	0.01
BW-30	March 29, 2011	B/W-30S	4329.67	B/W-30D1	4328.40	1.27	96.20	0.01
BW-31	March 29, 2011	B/W-31S1	4330.68	B/W-31D2	4329.75	0.93	133.60	0.01
BW-32	March 30, 2011	B/W-32S	4327.12	B/W-32D5	4328.92	-1.80	441.81	0.00
BW-34	March 30, 2011	B/W-34S	4329.88	B/W-34D1	4328.20	1.68	79.70	0.02
BW-34	March 30, 2011	B/W-34D1	4328.20	B/W-34B	4330.15	-1.95	54.30	-0.04
BW-36	March 29, 2011	B/W-36S	4334.25	B/W-36B	4334.87	-0.62	58.10	-0.01
BW-37	March 29, 2011	B/W-37S	4334.28	B/W-37D1	4334.38	-0.10	112.80	0.00
BW-37	March 29, 2011	B/W-37D1	4334.38	B/W-37B	4335.87	-1.49	52.00	-0.03
BW-38	March 29, 2011	B/W-38RS	4335.11	B/W-38RD1	4335.25	-0.14	109.40	0.00
BW-38	March 29, 2011	B/W-38RD1	4335.25	B/W-38RB	4335.33	-0.08	43.80	0.00
BW-40	March 30, 2011	B/W-40S	4328.38	B/W-40D3	4328.64	-0.27	260.28	0.00
BW-41	March 30, 2011	B/W-41S	4327.39	B/W-41D4	4326.54	0.85	320.49	0.00
BW-42	March 29, 2011	B/W-42S	4329.33	B/W-42D1	4328.60	0.73	115.10	0.01
BW-44	March 30, 2011	B/W-44S	4329.90	B/W-44D2	4330.00	-0.10	172.20	0.00
BW-44	March 30, 2011	B/W-44D2	4330.00	B/W-44B	4330.11	-0.11	28.30	0.00
BW-45	March 30, 2011	B/W-45S	4326.72	B/W-45D2	4326.93	-0.21	122.16	0.00
BW-46	March 30, 2011	B/W-46S	4327.90	B/W-46D1	4327.29	0.61	107.22	0.01
BW-51	March 30, 2011	B/W-51I1	4325.20	B/W-51I2	4325.31	-0.11	44.80	0.00
BW-51	March 30, 2011	B/W-51I2	4325.31	B/W-51B	4325.42	-0.11	60.30	0.00
BW-52	March 30, 2011	B/W-52S	4326.03	B/W-52D2	4325.64	0.39	152.20	0.00
BW-53	March 30, 2011	B/W-53I	4281.78	B/W-53B	4281.84	-0.05	30.09	0.00
BW-54	March 30, 2011	B/W-54I1	4313.38	B/W-54I2	4311.66	1.72	21.40	0.08
BW-54	March 30, 2011	B/W-54I2	4311.66	B/W-54B	4311.55	0.11	15.90	0.01
BW-55	March 28, 2011	B/W-55S	4328.77	B/W-55D2	4327.26	1.51	155.80	0.01

Table 3-2. 1Q 2011 Vertical Hydraulic Gradient Data

Location	Date	Shallow Well		Deep Well		Delta Head	Dist. Between Well Screen Midpoints	Calculated Gradient
		Well Name	Head (ft amsl)	Well Name	Head (ft amsl)	(feet)	(feet)	
BW-60	March 28, 2011	B/W-60S	4334.86	B/W-60D5	4331.52	3.34	460.90	0.01
BW-61	March 28, 2011	B/W-61S	4334.18	B/W-61D3	4331.15	3.03	305.00	0.01
BW-61	March 28, 2011	B/W-61D3	4331.15	B/W-61B	4327.19	3.96	352.80	0.01
BW-62	March 28, 2011	B/W-62S	4334.05	B/W-62D5	4331.35	2.70	499.80	0.01
BW-62	March 28, 2011	B/W-62D5	4331.35	B/W-62B	4331.12	0.23	143.30	0.00
BW-64	March 28, 2011	B/W-64S	4338.53	B/W-64D2	4333.30	5.23	172.00	0.03
BW-64	March 28, 2011	B/W-64D2	4333.30	B/W-64B	4332.70	0.60	85.80	0.01
BW-65	March 28, 2011	B/W-65S	4334.17	B/W-65D5	4330.17	4.00	569.80	0.01
BW-66	March 29, 2011	B/W-66S	4330.96	B/W-66D5	4329.29	1.67	547.80	0.00
BW-67	March 29, 2011	B/W-67S	4331.34	B/W-67D3	4329.58	1.76	204.20	0.01
LEP-MW-2	March 29, 2011	LEP-MW-2S	4328.83	LEP-MW-2D3	4328.89	-0.06	236.40	0.00
LEP-MW-2	March 29, 2011	LEP-MW-2D3	4328.89	LEP-MW-2B	4329.00	-0.11	59.70	0.00
MW2002-2	March 30, 2011	MW2002-2S	4328.98	MW2002-2D1	4329.10	-0.12	74.43	0.00
MW-4	March 30, 2011	MW-4S	4330.23	MW-4I	4330.20	0.03	43.04	0.00
MW-4	March 30, 2011	MW-4I	4330.20	MW-4B	4330.34	-0.14	33.80	0.00
MW-5	March 31, 2011	MW-5S	4330.96	MW-5D3	4331.53	-0.56	214.22	0.00
MW-5	March 30, 2011	MW-5D3	4331.53	MW-5B	4332.12	-0.59	134.92	0.00
W4CB	March 30, 2011	USGS-2BS	4334.32	W4CB-2D4	4331.41	2.91	364.91	0.01
W4CB	March 30, 2011	W4CB-2I	4333.78	W4CB-2D4	4331.41	2.37	341.25	0.01
W4CB	March 30, 2011	W4CB-2D4	4331.41	W4CB-2B	4326.95	4.46	467.15	0.01
W5AB	March 31, 2011	W5AB-2S	4331.71	W5AB-3I	4331.21	0.50	33.30	0.02
W5DB	March 31, 2011	W5DB-S	4334.10	W5DB-D4	4331.42	2.68	335.10	0.01

3.2 1Q 2011 Monitor Well Groundwater Quality Results

Active monitor wells (Figure 1-3) were sampled pursuant to the QAPP - Revision 5 and the GMP, and analyzed for the analyte list provided in Table 2-3. Wells not sampled included: 1) those designated as piezometers for water levels only; 2) six wells that were dry or nearly dry with extremely slow recharge (D5AC-1S, LEP-MW-7S, USEPA-2S, USGS-13S, W5AA-3S, and ST-A), and 3) two new wells that did not have pumps installed because of very slow recharge (W5DB-B) or no formation water (B/W-53S).

Each sample was collected for analyses of inorganic compounds, dissolved metals, and radiochemicals. The samples for dissolved metals and radiochemical analyses were field-filtered with a new, sealed 0.45 µm disposable filter. Field parameters measured at the time of sampling included pH, temperature, ORP, DO, specific conductivity, and turbidity. All monitor well samples were analyzed by TestAmerica as follows: 1) the Irvine, California laboratory analyzed the samples for dissolved metals and inorganic compounds; 2) the Richland, Washington laboratory analyzed the samples for radiochemicals and isotopes (uranium, radium, thorium, gross alpha, and gross beta).

The analytical laboratories provided the certified clean sampling bottles, chemical preservatives, coolers, and custody seals. Appendix C-1 provides an electronic copy (Excel format) of the field chemistry and analytical results for pumpback and monitor wells sampled during the 1Q 2011 monitoring period. Also, Appendix C-2 includes an electronic summary (Excel format) of all quarterly field chemistry and analytical sampling results dating from 1978 – 1Q 2011. An updated version of the groundwater database (Access format) is included in Appendix C-3.

Appendix D provides the distribution of pH (field), sulfate, uranium, total alkalinity, arsenic, and nitrate in groundwater are included in. Time-concentration plots for the shallow, intermediate, and deep zone of the alluvial aquifer, and for bedrock, are presented in Appendices E-1, E-2, E-3 and E-4, respectively.

Field forms including the groundwater sampling log forms and the field meter instrument calibration forms are presented as Appendices F-1 and F-2, respectively. Field log books for the sampling activities are presented in Appendix G. Appendices H-1, H-2, and H-3 contain electronic copies of the analytical laboratory reports, data verification reports, and data validation reports, respectively. Appendix I consists of water level data for the pit lake and an associated hydrograph. Appendix J consists of diagrams illustrating major ion chemistry (as Plates). All groundwater chemical data are provided in Appendix C-3 in Access format as direct output from the Yerington Project database.

3.2.1 Major Ion Chemistry

Major ion chemical characteristics of groundwater samples collected from monitor wells screened in the shallow, intermediate and deep zones of the alluvial aquifer, and in bedrock, are illustrated in Appendices J-1, J-2, J-3 and J-4, respectively, using Stiff diagrams. Stiff diagrams provide a quick method to visually compare the major ion chemistries of individual samples using a polygon that represents major cations (sodium [Na^{+},], calcium [Ca^{+2}], and magnesium [Mg^{+2}]) and major anions (chloride [Cl^{-}], bicarbonate [HCO_3^{-}], and sulfate [SO_4^{-2}] typically found in groundwater). The convention used to describe major ion compositions of the groundwater samples is to identify the predominant cation followed by the predominant anion (e.g., Ca-HCO_3). Secondary cations or anions are presented in parentheses if considered significant relative to the primary ion.

Major ion chemistry in the alluvial aquifer varies laterally and vertically due to a variety of factors including but not limited to: compositional differences of various waters that recharge the alluvial aquifer and bedrock, water rock interactions and residence time, and anthropogenic inputs. General characteristics and observations regarding the major ionic composition of the groundwater samples collected during 1Q 2011 are provided below.

Shallow Zone

The major ionic composition of alluvial groundwater in the shallow zone is spatially variable (Appendix J-1). The following discussion of major ion chemistry first addresses surface water followed by shallow alluvial groundwater in the following general order: 1) along the south, east, north, and west boundaries of the Site; 2) beneath the interior of the Site including the Evaporation Ponds, Sulfide Tailings, and Process Areas; and 3) beneath the agricultural field immediately northeast of the mine Site.

Surface water in the Walker River (at SW-WR-01) and West Campbell Ditch (SW-WCD-01) exhibits a Na-HCO3 signature. Water in the Yerington Pit Lake (from the 0-1 meter depth interval) exhibits a Na-HCO_3(SO_4) signature.

Shallow zone alluvial groundwater exhibits a Na-HCO_3 signature at several locations including: 1) southeast of the mine Site near the Walker River (e.g., B/W-15S and B/W-20S); 2) east and northeast of the mine Site near West Campbell Ditch (e.g., B/W-64S and B/W-27S); 3) in the northern portion of the Site (e.g., LC-MW-5S, B/W-55S, B/W-30S, B/W-52S); and 4) west of the Site adjacent to the Singatse Range (e.g., B/W-40S and B/W-16S).

Beneath the Evaporation Ponds, Sulfide Tailings, and to the north as far as monitor well B/W-32S, shallow alluvial groundwater exhibits a Na(Mg)-SO_4 signature and concentrations of TDS exceed 2,000 mg/L. At B/W-32S, groundwater exhibits a Na-SO_4(Cl) signature. Although the Stiff diagram at this location is generally similar to the Stiff diagrams for shallow groundwater beneath the Evaporation Ponds, the major ion chemistry is notably different from other locations in the shallow alluvial groundwater both beneath the Evaporation Ponds and elsewhere throughout the Site due to the predominance of Na and Cl. Beneath the agricultural fields and to the northwest into Sunset Hills, shallow alluvial groundwater exhibits a Ca(Na,Mg)-SO_4 signature. Concentrations of TDS in shallow groundwater beneath the agricultural fields are less than TDS concentrations in groundwater beneath the Evaporation Ponds. In the Process Areas, shallow alluvial groundwater exhibits a Ca-HCO_3(SO_4) signature.

Intermediate Zone

Intermediate zone wells (Appendix J-2) exhibit a Ca-HCO_3 to Ca(Na/Mg)-HCO_3 signature at several locations including: 1) northeast of the Site near West Campbell Ditch (e.g., B/W-30I); and 2) the northern portion of the Site (e.g., B/W-54I1, B/W-54I2, and B/W-52I). To the west of the Site, intermediate zone groundwater exhibits a Na-SO_4(HCO_3) signature. The major ion signature at these locations is similar to the signature in shallow alluvial wells located southeast of the Site near the Walker River (e.g., B/W-15S, B/W-20S, and B/W-21S).

Alluvial groundwater in the intermediate zone beneath the Evaporation Ponds and Sulfide Tailings exhibits a Ca(Na)-SO_4 and/or Na(Ca)-SO_4 signature (except at MW-5I) and concentrations of TDS are greater that other intermediate zone sample locations. At MW-5I, groundwater exhibits a Mg-SO_4 signature. Intermediate zone groundwater beneath the agricultural field and northwest into Sunset Hills exhibits a Ca(Mg)-SO_4 signature.

Deep Zone

Deep zone wells (Appendix J-3) exhibit a Ca-HCO_3 signature at: 1) east/northeast of the Site near West Campbell Ditch (e.g., B/W-64D1, B/W-64D2, B/W-27D3a, and B/W-27D3b); and 2) in the northern portion of the Site (e.g., B/W-55D1, B/W-55D2, B/W-52D2, and B/W-10D1). The major ion chemistry signature at these locations is similar to the signature in shallow alluvial wells located southeast of the Site near the Walker River (e.g., B/W-15S, B/W-20S, and B/W-21S). To the west of the Site, groundwater exhibits a Na-HCO_3(SO_4) signature.

Deep zone groundwater beneath the Evaporation Ponds exhibits a predominantly Ca-SO_4 signature (except at B/W-11D2 which exhibits a Mg-SO_4 signature), with TDS values greater than 1,000 mg/L. Groundwater east and in the northern portion of the Site exhibits a Ca-HCO_3 that is similar to the signature of surface water in West Campbell Ditch and the Walker River.

Bedrock

The major ion chemistry of bedrock groundwater during 1Q 2011 is shown on Appendix J-4. All of the bedrock monitor wells shown on this figure were first sampled in 1Q 2011 except for monitor wells B/W-11B and B/W-23B, which have been sampled quarterly since the wells were installed in November and August 2007, respectively. Monitoring results from B/W-11B indicate intrusion of overlying alluvial groundwater into the bedrock during initial well installation and (despite achievement of well development criterion for turbidity) several quarters of sampling in this low-yield well were required before chemical concentrations decreased to stable values that represented bedrock chemistry at this location.

Trends in chemical concentrations at B/W-11B are shown in the time-concentration plots presented in Appendix E. An evaluation of the trend data at B/W-11B indicate that data prior to 1Q 2009 may not represent bedrock groundwater quality at this location. In addition, two stiff diagrams are shown on Appendix J-4 for B/W-11B to illustrate the differences in major ion chemistry between the initial 1Q 2008 and 1Q 2011 sampling events. At B/W-23B, the alluvium was unsaturated; consequently, all groundwater data are considered representative of bedrock groundwater quality at this location.

Given the potential for intrusion of water into bedrock during installation of new bedrock monitor wells constructed in 2010, despite rigorous well construction methods used by ARC to limit such intrusion, the major ion chemistry illustrated on Appendix J-4 and chemical data presented throughout this 1Q 2011 GMR for the new bedrock wells should be considered preliminary. Major ion chemical data to be collected from bedrock wells during future quarterly monitoring events will either confirm or modify these preliminary results from 1Q 2011.

3.2.2 Distribution of Select Parameters

Historic monitoring has indicated that low to moderate pH values, and elevated sulfate and uranium (dissolved) concentrations are indicator parameters for mine-related groundwater at the Site. Therefore, the distributions of these indicator parameters for the shallow, intermediate, deep, and bedrock zones, respectively, are indicated on the figures in Appendix D. In addition, figures illustrating the distributions of total alkalinity as $CaCO_3$ (alkalinity), arsenic (dissolved), and nitrate as N (nitrate) are also included in Appendix D.

<u>pH (Field)</u>

Field-measured pH values in the shallow zone ranged from 3.59 in W5DB-S to 8.42 in LEP-MW-1S. Values of less than 5 were measured in several wells (W5DB-S, PW-1S, B/W-11S, and MW-5S) located adjacent to the unlined evaporation pond (UEP). The pH values increase generally concentrically from this grouping such that values of between 6 and 7 were measured in most wells near the northern portion of the lined evaporation pond (LEP). The monitor wells north of Luzier Lane to the northern portion of the Site generally have pH values ranging from between 7.0 to 7.5. Values between 6 and 7 were also measured in several wells in the agricultural fields (e.g., B/W-1S, B/W-65S, and B/W-64S). Values of pH greater than 8 were measured in several wells west and northwest of the LEP.

Intermediate zone pH values ranged from 5.98 in W4CB-2I to 9.05 in B/W-32I. Deep zone pH values ranged from 6.05 in MW-5D2 to 8.72 in B/W-40D3. Bedrock, pH values ranged from 6.64 in MW-5B to 9.02 in B/W-2B. Lower pH values, between 6.0 and 7.0, were generally measured beneath the UEP and LEP.

Sulfate

Shallow zone, sulfate values ranged from 27 mg/L in B/W-15S to 27,000 mg/L in W5DB-S. The most elevated sulfate values were observed beneath the Evaporation Ponds and Sulfide Tailings, and the values generally decrease concentrically from this area. Elevated sulfate (19,000 mg/L) also occurs at B/W-32S, located about 2,000 feet north of the mine Site boundary. The 1,000 mg/L iso-concentration contour encompasses, and extends north of, the hot-spot area around B/W-32S. The 500 mg/L iso-concentration contour extends farther north to B/W-4S.

In general, the distribution of sulfate values that exceed 500 to 1,000 mg/L is consistent with the northwest groundwater flow direction. Sulfate values exceed 500 mg/L in groundwater beneath the agricultural fields. The 250 mg/L iso-concentration contour extends farther north from B/W-4S to include B/W-8S, B/W-46S, and B/W-28S. Wells located outside of the 250 mg/L contour include those located to the: 1) south of the Site adjacent to the Walker River; 2) east and northeast of the Site adjacent to West Campbell Ditch; 3) at the northern end of the Site (B/W-10S, B/W-52S, and B/W-55S); and 4) west of the Site adjacent to the Singatse Range.

In the intermediate zone, sulfate values ranged from 20 mg/L in B/W-32I to 6,800 mg/L in MW-5I. Sulfate values in the intermediate zone are most elevated beneath the Evaporation Ponds (adjacent to the Phase IV Heap Leach Pad) and Sulfide Tailings. Sulfate values ranging from 250 to 500 mg/L were detected in intermediate zone groundwater beneath the agricultural fields and in some locations northwest of the Site near the Singatse Range. Sulfate values less than 100 mg/L were detected in wells located to the: 1) east and northeast of the Site adjacent to the West Campbell Ditch (e.g., B/W-27I and B/W-30I); and 2) at the northern end of the Site (e.g., B/W-54-I1, B/W-54I2, B/W-52I.

Deep zone sulfate values ranged from 14 mg/L in B/W-3D1 located north of Luzier Lane to 4,100 mg/L in B/W-11D2. Sulfate values in the deep zone are most elevated beneath the Evaporation Ponds and Sulfide Tailings. Elevated sulfate values in the deep zone extend beneath the agricultural fields from the Evaporation Ponds near W4CB-2D3 (1,800 mg/L) through B/W-61D3 (1,400 mg/L) toward B/W-1D5 (560 mg/L). Sulfate concentrations less than 100 mg/L were detected in wells located to the: 1) east and northeast of the Site adjacent to West Campbell Ditch (e.g., B/W-64D1, B/W-64D2, B/W-27D3a, and B/W-27D3b); and 2) at the northern end of the Site (B/W-30D1, B/W-55D1, B/W-55D2, B/W-52D2, and B/W-10D1).

Bedrock sulfate values ranged from 39 mg/L in B/W-61B, which is located in the agricultural fields, to 2,000 mg/L in B/W-36B, which is located in the Sulfide Tailings.

<u>Uranium</u>

Dissolved (i.e., field-filtered) uranium values in the shallow zone ranged from 0.99U micrograms per liter (µg/L) in LC-MW-2S to 3,400 µg/L in MW-5S. Uranium values in the shallow zone are generally most elevated beneath the Evaporation Ponds (e.g., adjacent to the Phase IV Heap Leach Pad) and decrease concentrically away from MW-5S. The 100 µg/L iso-concentration contour encompasses the area defined by B/W-32S, where uranium is 1,100 µg/L and extends north from Luzier Lane to include B/W-31S2 and other wells located on the northern end of the agricultural fields. West of the Site, adjacent to the Singatse Range, uranium values range from approximately 35 to 60 µg/L. Uranium values less than 30 µg/L were detected in shallow zone wells located: 1) to the south of the Site adjacent to the Walker River; 2) at the northeast corner of the Sulfide Tailings (B/W-38RS); 3) east and northeast of the Site adjacent to West Campbell Ditch (B/W-64S and B/W-27S); 4) at the northern end of the Site (B/W-10S, B/W-52S, B/W-55S, and B/W-30S/others); and 5) immediately west of the LEP.

Intermediate zone uranium values ranged from 5.5 µg/L (B/W-66I) to 540 µg/L (W5DB-I, located between the UEP and LEP), and were generally most elevated beneath the Evaporation Ponds and rapidly decrease concentrically away from W5DB-I. In the vicinity of the agricultural fields, uranium concentrations range from 140 µg/L in B/W-65I to 81 µg/L in B/W67I; uranium in this area extends northwest in the general direction of groundwater flow to B/W-4I (51 µg/L), which is located in Sunset Hills. Uranium values less than 30 µg/L were detected in intermediate zone wells located: 1) northeast of the Site adjacent to West Campbell Ditch (B/W-27I); and 2) at the northern end of the Site (B/W-10S, B/W-28I, B/W-51I1, B/W-51I2, B/W-52I, B/W-53I, and B/W-54I1). Uranium was detected in B/W-54I2 at a concentration of 35 µg/L.

Deep zone uranium values ranged from 1.3 µg/L in B/W-67D3 to 1,500 µg/L in MW-5D2, and were most elevated beneath the Evaporation Ponds (e.g., adjacent to the Phase IV Heap Leach Pad). Elevated uranium values occur beneath the agricultural fields and the Evaporation Ponds, from W4CB-2D3 (500 µg/L) to B/W-61D3 (300 µg/L) and B/W-1D5 (350 µg/L). Near the Singatse Range, uranium values ranged from 38 µg/L (B/W-19D1) to 72 µg/L (B/W-41D2). Uranium values less than 30 µg/L were detected in deep zone wells located: 1) east and northeast of the Site adjacent to West Campbell Ditch (e.g., B/W-64D1, B/W-64D2, B/W-27D3a and B/W-27D3b); 2) from Luzier Lane to the northern end of the Site at B/W-10D1; and 3) beneath the agricultural fields.

Bedrock uranium values ranged from 0.87J µg/L in B/W-2B, which is located immediately north of the Site boundary, to 580 µg/L in MW-5B, which is located adjacent to the Phase IV Heap Leach pad.

Total Alkalinity

In the shallow zone, Total Alkalinity as $CaCO_3$ (alkalinity) ranged from less than 2 mg/L at MW-5S and other wells in the Evaporation Ponds and Sulfide Tailings to 1,600 mg/L in PW-10S. Alkalinity concentrations above 500 were detected in the Process Areas in wells PA-MW-2S and PA-MW-3S. Concentrations of alkalinity in wells adjacent to the Walker River and West Campbell Ditch, and adjacent to the Singatse Range, typically ranged from 120 to 190 mg/L.

In the intermediate zone, alkalinity ranged from 98 mg/L in B/W-9I to 2,700 mg/L in MW-5I. Alkalinity was most elevated beneath the Evaporation Ponds. In the agricultural fields, alkalinity was typically about 200 to 300 mg/L, except where alkalinity was less than 100 mg/L in an area that included W5AA-1I, B/W-9I, B/W-2I, B/W-66I, and B/W-3I.

Deep zone alkalinity values ranged from 92 mg/L (B/W-66D1) to 2,100 mg/L (B/W-11D2), and was most elevated in the deep zone beneath the Evaporation Ponds and the agricultural fields.

Bedrock alkalinity values ranged from 97 mg/L at B/W-37B (beneath the Sulfide Tailings) to 870 mg/L at MW-5B, which is located adjacent to the Phase IV Heap Leach Pad.

<u>Arsenic</u>

Shallow zone dissolved (i.e., field filtered) arsenic values ranged from 0.9U µg/L in PW-1S (the eastern side of the PWS adjacent to the agricultural fields) to 320 µg/L in B/W-32S (located approximately 2,000 feet north of the Site boundary). With the exception of B/W-32S, arsenic values in the shallow zone were most elevated beneath the Evaporation Ponds and Sulfide Tailings. Arsenic values less than 20 µg/L were detected in shallow zone wells located: 1) to the south adjacent to the Walker River (except B/W-14S where the arsenic value was 92 µg/L): 2) in the agricultural fields located adjacent to the Site; 3) east and northeast of the Site adjacent to West Campbell Ditch; 4) in the Sunset Hills area; 5) adjacent to the Singatse Range; and 6) in the Process Areas. The 10 µg/L iso-concentration contour may extend north to B/W-28S, if data from B/W-4S (6.7 µg/L) and B/W-45S (2.2 µg/L) are not considered for contouring purposes.

Concentrations of arsenic in the intermediate zone ranged from 2.8U µg/L at B/W-29I to 45 µg/L at B/W-34I. Similar to the shallow zone, arsenic concentrations in intermediate zone groundwater are highest in an area located immediately west and northwest of the LEP. Arsenic concentrations less than 10 µg/L were detected in intermediate zone wells located: 1) in the Evaporation Ponds and Sulfide Tailings; 2) in the agricultural fields immediately northeast of the mine Site; 3) to the northeast of the Site adjacent to West Campbell Ditch; and 4) in the Sunset Hills area. At the north end of the Site, arsenic is present in intermediate zone monitor wells (e.g., B/W-51I1, B/W-51I2, B/W-53I, B/W-54I1, and B/W-54I2) at concentrations above 10 to 20 µg/L.

Concentrations of arsenic in the deep zone ranged from 3.5U µg/L in B/W-62D5 to 90 µg/L in B/W-45D2. Similar to the shallow and intermediate zones, arsenic concentrations in deep zone groundwater are highest in an area located immediately west and northwest of the LEP.

In bedrock groundwater, concentrations of arsenic ranged from 0.9U µg/L in B/W-37B, which is located in the Sulfide Tailings, to 45 µg/L in B/W-34B, which is located immediately west of the Evaporation Ponds.

Nitrate

Concentrations of nitrate as N (nitrate) in the shallow zone ranged from less than 0.15 mg/L at many locations to 57 mg/L at B/W-61S. Nitrate values were most elevated in the shallow zone beneath the agricultural fields (generally above 20 mg/L). Nitrate values above 3 to 5 mg/L extend from the agricultural fields northwest into the Sunset Hills area. Nitrate values of 2 to 5 mg/L appear to extend from the Oxide Tailings to the west side of the Evaporation Ponds.

In the intermediate zone, nitrate values ranged from 0.06U mg/L at numerous locations to 8.6 mg/L at B/W-61D3. Similar to the shallow zone, nitrate concentrations in deep zone groundwater are highest beneath the agricultural fields.

Deep zone nitrate values ranged from 0.06U mg/L at numerous locations to 4.6 mg/L at B/W-65I1. Similar to the shallow and intermediate zones, deep zone nitrate values are most elevated beneath the agricultural fields. Nitrate values in the deep zone are greater than 1 mg/L in two other locations at the Site: 1) immediately adjacent to the LEP around B/W-44D1 and B/W-44D2; and 2) in the northwestern portion of the Site at B/W-19D1.

Bedrock nitrate values ranged from 0.06U at many locations to 4.4 mg/L at B/W-22B, which is located west of the Phase IV Heap Leach pad.

3.3 1Q 2011 Pit Lake Water Level Monitoring Results

A pressure transducer was installed by ARC in the pit lake in September 2007 to monitor surface water levels on an hourly basis. A hydrograph of lake water levels from September 28, 2007 through March 31, 2011, based on monthly data, is provided in Appendix I. The hydrograph indicates that the lake water levels continue to slowly rise following a projected curve, approaching a “steady state” elevation projected for the lake of approximately 4,240 feet amsl.

SECTION 4.0

QUALITY ASSURANCE/QUALITY CONTROL SUMMARY

QA/QC procedures were performed in accordance with the updated QAPP - Revision 5 (ESI and Brown and Caldwell, 2009) and the *Site-Wide Groundwater Monitoring Plan - Revision 1* (Brown and Caldwell, 2009). The QAPP incorporates the following items: standard operating procedures, equipment calibration and maintenance, independent audit, field and laboratory QC samples, data validation, corrective action, and data completeness.

4.1 Data Quality Indicators

As defined in the QAPP, data QA is assessed using the following data quality indicators (DQIs).

- **Data Precision.** The degree of agreement between repeated, independent measurements. Field measurement precision is determined by replicate sample measurements. The precision of laboratory analysis is determined by replicate sample analyses and/or replicate matrix spike sample analyses. Precision, as relative percent difference (RPD), is calculated by dividing the difference of the replicate analytical results by the mean of the replicate analytical results.
- **Data Bias.** The systematic distortion of a measurement process that causes errors to skew the data in one direction. Data bias is addressed in the field and laboratory by calibrating equipment.
- **Data Accuracy.** The degree to which the sample result agrees with the actual concentration of a parameter. The accuracy of laboratory measurements is determined by the analyses of matrix spike samples, laboratory control samples, and surrogate spike samples.
- **Data Representativeness.** The degree to which a data set can accurately and precisely characterize the environment and the parameter conditions at the point of sample. Data representativeness is attained through proper design of the sampling program and should be constantly assessed.
- **Data Completeness.** The degree to which the proposed sampling locations yield usable data of the type requested (data that was not rejected). Percent (%) completeness is calculated by dividing the number of usable data points by the number of proposed sample collection points.
- **Data Comparability.** The confidence with which one data set can be compared to another data set. Data comparability will be achieved by using standard sampling procedures and analytical techniques, and by documenting all QA/QC measures and procedures. QA/QC procedures are considered when comparing data sets.

- **Data Sensitivity.** The ability for the analytical method to differentiate between various levels of the measured parameter. Results between the reporting limit and the laboratory method detection limits (sample-specific minimum detectable activity for radiological analyses) are reported for all analyses.

These DQIs, assessed during the data review and validation process, included checks to ensure that all data is properly entered into the project database. Analytical data that failed to meet the QA objectives have been qualified as to usability, and potential high or low bias, during the review process. Analytical data were also reviewed in the context of project-specific limits provided in the QAPP, and the National Functional Guidelines for Data Review as posted on the EPA web site http://www.epa.gov/superfund/programs/clp/guidance.htm.

4.2 Field Quality Control

QC samples were collected and analyzed to assess accuracy and precision of field and laboratory activities. In accordance with the QAPP, standard analytical QC checks are described below:

- **Field Blanks.** Field blanks are samples of laboratory reagent grade water that are filtered through new 0.45 µm filters and poured into project sample containers in the field setting and are used to assess the potential contamination of samples during sample collection. Field blanks were collected at a rate of one per 20 samples collected. During the 1Q 2011 sampling event, twelve field blanks were collected.
- **Field Duplicates.** Analyses of field duplicate samples are used to check for sampling and analytical error, reproducibility, and homogeneity. Field duplicates were collected at a rate of one per ten samples collected. During the 1Q 2011 sampling event, 23 field duplicate samples were collected.
- **Matrix Spike/Matrix Spike Duplicate (MS/MSD) Samples.** MS/MSD samples are investigative samples to which known amounts of analytes are added in the laboratory before extraction, preparation, and analysis. The recoveries for spiked compounds can be used to assess how well the method used for analysis recovers target compounds in the Site-specific sample matrices. MS/MSD samples were collected at a rate of one per 20 samples collected. During the 1Q 2011 sampling event, twelve MS/MSD samples were collected.
- **Temperature Blanks.** Temperature blanks are aliquots of analyte-free water used by the laboratory to record sample cooler temperature upon receipt at the laboratory. One temperature blank was included in each cooler where temperature preservation was required through the use of ice. The temperature blank allows the lab to confirm that samples were preserved at the required temperature without using field samples.

Preparation of groundwater samples in the field for transport to the laboratory, including handling, labeling, packaging, documentation, shipment preparation, and custodial control, was conducted in accordance with the QAPP. COC procedures were followed for all samples submitted to the laboratory for analysis, including the documentation of the following:

- Sample identification;
- Date and time of collection;
- Sampler's name;
- Number of containers;
- Preservation method for each container; and
- Analysis requested.

The sampler relinquished custody of the samples by signing the appropriate section of the COC prior to shipment. The laboratory accepted custody of the samples by signing the COC upon receipt of the samples at the laboratory. Similar information was also included on the labels affixed to each sample container. Custody seals were placed on the outside of each cooler to ensure the samples were not tampered with during storage and transport.

4.3 Data Verification and Validation

Laboratory data were reviewed by a third-party data quality reviewer, ESI, in accordance with the QAPP. The verification and validation reports prepared by ESI, provided in Appendix H, qualify the analytical data for accuracy and usability, and identify data reduction errors. In addition to the laboratory QA review, the fully documented data packages are evaluated for compliance with requested testing, completeness, and confirmation of receipt of requested items.

During 1Q 2011, Level II data verification was performed on 60% of the data and Level IV data validation was completed on 40% of the data. The QAPP requires Level IV validation on 20% of all samples for each project. Therefore, validation was completed on 40% of samples from the 1Q 2011 sampling event and none will be performed for the 2Q 2011 sampling event to achieve a total of 20% validated data for the combined first and second quarters of 2011.

The specific measures evaluated during verification and the associated criteria are addressed in the QAPP. Full data validation includes the review of the QC measures reviewed during the data verification, and also includes the review of the summary forms for all QC procedures and all sample and quality control raw data to support the reported results.

Laboratory results that met all the data quality objectives have been accepted without qualification. Results associated with QC parameters that did not meet objectives have either been qualified as estimated (J) or rejected as unusable (R). Data qualified as estimated are considered usable for their intended purpose, although the reported result may not be accurate or precise. Data that is detected at concentrations less than the laboratory method detection limit (MDL) are reported as non-detected (U).

4.4 Data Quality Summary

A total of 223 normal and 23 field duplicate water matrix samples were collected and analyzed. All aqueous samples from the monitor wells were analyzed for the full list of parameters in Table 2-3, with the exception of the following.

- The sample from B/W-41D4 was not analyzed for radiological parameters because of limited sample volume. The sample was highly turbid and was clogging the sample filters.

Overall, the data achieved the data quality objectives, no results were rejected, and all data are considered usable for the stated purposes. Completeness goals were met for every method and analyte. The primary issues that resulted in data qualification were:

- High and low MS recoveries, blank contamination, serial dilution issues, and field duplicate imprecision for inductively coupled plasma (ICP) metals.
- Blank contamination, serial dilution issues, and field duplicate imprecision for inductively coupled plasma-mass spectrometer (ICP-MS) metals.
- Low MS recoveries for mercury.
- Holding time exceedances and MS recoveries for anions.
- High and low MS recoveries for gross alpha and gross beta.
- High and low spike recoveries for radium-226.
- Low MS recoveries for radium-228.

- Blank contamination for isotopic thorium.
- Holding time exceedances for pH.
- Field duplicate imprecision for TOC.

Results qualified as estimated should be used with caution.

Table 4-1 provides a summary of the number of samples analyzed by each method and the number of results that were qualified for each method.

Table 4-1. Analytical Completeness by Method

				Number of Results				Completeness	
Method	**Parameter**	**Samples Analyzed (N+FD)**	**Analytes per sample**	**Total**	**Rejected**	**Estimated due to QC deficiencies**	**Estimated due to >MDL but <PQL**	**Percent usable**	**Percent quantitative***
E200.7	ICP Metals	223+23	13	3198	0	162	172	100%	94.9%
E200.8	ICP-MS Metals	223+23	18	4428	0	539	415	100%	87.8%
E245.1	Mercury	223+23	1	246	0	20	6	100%	91.9%
E300	Anions	223+23	6	1476	0	184	96	100%	87.5%
E900.0	Gross Alpha and Beta	222+23	2	490	0	48	31	100%	90.2%
E903.0	Total Alpha Radium (Ra-226)	222+23	1	245	0	21	43	100%	91.4%
E904.0	Radium-228	222+23	1	245	0	23	23	100%	90.6%
HASL 300	Isotopic Thorium	222+23	2	490	0	48	25	100%	90.2%
SM2320B	Alkalinity (as $CaCO_3$)	223+23	4	984	0	0	0	100%	100%
SM2540C	Total Dissolved Solids	223+23	1	246	0	0	0	100%	100%
SM4500	pH (lab)	223+23	1	246	0	245	0	100%	0.4%
SM5310B	Total Organic Carbon	223+23	1	246	0	8	9	100%	96.7%

Notes: * Estimations due solely to results <PQL do not affect the calculated completeness
Calculations do not include any required field or laboratory QC samples, except field duplicates.
N = normal environmental samples FD = field duplicate samples
MDL = method detection limit PQL = practical quantitation limit
ICP = inductively coupled plasma ICP-MS = inductively coupled plasma-mass spectrometry

SECTION 5.0
REFERENCES

Brown and Caldwell, 2005, *First-Step Hydrogeologic Framework Assessment (HFA) Yerington Mine Site, Lyon County, Nevada.* Prepared for the Atlantic Richfield Company. April 22.

Brown and Caldwell, 2007, *Second-Step Hydrogeologic Framework Assessment (HFA) Yerington Mine Site, Lyon County, Nevada.* Prepared for the Atlantic Richfield Company. February 28.

Brown and Caldwell, 2008, *Pumpback Well System Characterization Work Plan Yerington Mine Site, Lyon County, Nevada.* Prepared for the Atlantic Richfield Company. December 30.

Brown and Caldwell, 2009, *Site-Wide Groundwater Monitoring Plan – Revision 1, Yerington Mine Site, Lyon County, Nevada.* Prepared for the Atlantic Richfield Company. December 15.

Brown and Caldwell, 2010a, *2009 Annual Groundwater Monitoring Report Yerington Mine Site, Lyon County, Nevada.* Prepared for the Atlantic Richfield Company. March 8.

Brown and Caldwell, 2010b, *2010 Groundwater Monitor Well Work Plan, Revision 2, Yerington Mine Site, Lyon County, Nevada.* Prepared for the Atlantic Richfield Company. July 22.

Brown and Caldwell, 2010c, *Agricultural Field Characterization Work Plan, Revision 2, Yerington Mine Site, Lyon County, Nevada.* Prepared for the Atlantic Richfield Company. July 20.

Brown and Caldwell, 2010d, *Implementation Work Plan – Revision 3, Anaconda Evaporation Pond Removal Action (Thumb Pond and Sub-Area A), Yerington Mine Site, Lyon County, Nevada.* Prepared for the Atlantic Richfield Company. October 25, 2010.

EPA, 2007, Administrative Order for the Remedial Investigation and Feasibility Study. In the matter of Anaconda / Yerington Mine Site, Yerington, Lyon County, Nevada. Atlantic Richfield, Respondent. U.S. EPA Region 9, Docket No. 9-2007-0005. Proceeding under Section 106(a) of CERCLA, as amended, 42 USC § 9606(a). Including Attachment A: Scope of Work for the Remedial Investigations / Feasibility Studies Continued Response Action. January.

ESI and Brown and Caldwell, 2009, *Quality Assurance Project Plan - Revision 5, Yerington Mine* Site. Prepared for the Atlantic Richfield Company. May 15.

Seitz, H.R., A.S. Van Denburgh, and La Carma, R.J., 1982, Ground-Water Quality Downgradient from Copper-One Milling Wastes at Weed Heights, Lyon County, Nevada. U.S. Geological Survey, Open-File Report 80-1217.